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(71) Applicant: **SUMITOMO CHEMICAL COMPANY,
LIMITED**
5-33, Kitahama 4-chome Chuo-ku
Osaka(JP)

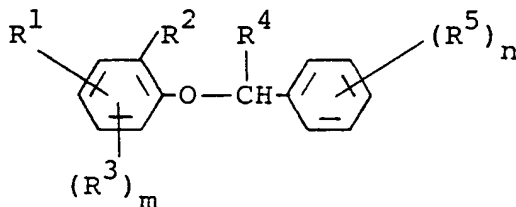
(72) Inventor: **Shuto, Akira**
2-14-7, Mefu
Takarazuka, Hyogo(JP)
Inventor: **Sakamoto, Noriyasu**
4-1-404, Ryodo-cho

Nishinomiya, Hyogo(JP)
Inventor: **Kisida, Hiroshi**
2-1-12-402, Nigawatakamaru
Takarazuka, Hyogo(JP)
Inventor: **Fujimoto, Hiroaki**
2-5-1-606, Higashiizumigaoka
Toyonaka, Osaka(JP)
Inventor: **Umeda, Kimitoshi**
2-11-8-307, Sonehigashino-cho
Toyonaka, Osaka(JP)
Inventor: **Matsuo, Noritada**
29-2, Minaminoazayamamichi
Itami, Hyogo(JP)

(74) Representative: **Vossius & Partner**
Siebertstrasse 4 P.O. Box 86 07 67
W-8000 München 86(DE)

(54) **Aromatic compounds, their production processes and their compositions for the control of insect pests.**

(57) An aromatic compound of the formula:



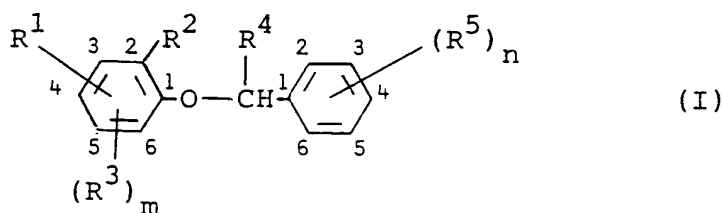
which is useful for control of insect pests.

EP 0 504 812 A2

The present invention relates to aromatic compounds, their production processes and their compositions for the control of insect pests.

It is described in U.S. Patents 3,987,102, 4,094,989 and 4,153,731 that certain aromatic compounds are useful as insecticides and acaricides. But, their insecticidal and acaricidal activities are still not satisfactory.

It is the object of the invention to provide novel aromatic compounds producing a satisfactory controlling effect on insect pests. This object has been achieved on the basis of the finding that compounds of the following formula exhibit a remarkable juvenile hormone-like activity and can control significantly the growth of insect pests:



wherein R¹ is a C₃-C₈ alkyl group, a C₃-C₈ alkoxy group, an alkoxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ alkenyl group, a C₃-C₈ alkenyloxy group, an alkenyloxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ haloalkyl group, a C₃-C₈ haloalkoxy group, a haloalkoxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ haloalkenyl group, a C₃-C₈ haloalkenyloxy group, a haloalkenyloxyalkyl group having 3 to 8 carbon atoms or a C₃-C₈ alkynyloxy group; R² is a halogen atom; R³ is, the same or different, a hydrogen atom, a halogen atom or a methyl group; R⁴ is a hydrogen atom or a methyl group; R⁵ is, the same or different, a hydrogen atom, a halogen atom, a C₁-C₄ alkyl group, a C₁-C₄ haloalkyl group, a C₁-C₄ alkoxy group, a C₁-C₄ haloalkoxy group, a C₁-C₄ alkylthio group, a C₁-C₄ haloalkylthio group, a 3,4-methylenedioxy group, a methoxymethyl group, a cyano group or a nitro group; m is an integer of 1 to 3; and n is an integer of 1 to 5.

The aromatic compounds (I) of the invention have an excellent juvenile hormone-like activity against insect pests. They exhibit various actions such as metamorphosis inhibition, embryogenesis inhibition and sterilization and are thus efficacious as growth regulators, chemosterilants, ovicides or reproduction inhibitory agents on various insect pests such as agricultural, forestal, hygienic and stored grain insect pests. They are also efficacious against insect pests having an increased resistance to commercial insecticides.

In the formula (I) which represents the aromatic compounds of the invention, examples of the C₃-C₈ alkyl group represented by R¹ are n-propyl, isopropyl, n-butyl, sec-butyl, isobutyl, tert-butyl, n-pentyl, neopentyl, 2-methylbutyl, 1-methylbutyl, 1-ethylpropyl, 1,1-dimethylpropyl, n-hexyl, 1-methylpentyl, 2-methylpentyl, 3-methylpentyl, 4-methylpentyl, 3,3-dimethylbutyl, 2,2-dimethylbutyl, 1,1-dimethylbutyl, 2-ethylbutyl, 1-ethylbutyl, 1,3-dimethylbutyl, n-heptyl, 5-methylhexyl, 4-methylhexyl, 3-methylhexyl, 2-methylhexyl, 1-methylhexyl, 3-ethylpentyl, 2-ethylpentyl, 1-ethylpentyl, 4,4-dimethylpentyl, 3,3-dimethylpentyl, 2,2-dimethylpentyl, 1,1-dimethylpentyl, n-octyl, 6-methylheptyl, 5-methylheptyl, 4-methylheptyl, 3-methylheptyl, 2-methylheptyl, 1-methylheptyl, 1-ethylhexyl, 1-propylpentyl, 3-ethylhexyl, 5,5-dimethylhexyl, 4,4-dimethylhexyl, 2,2-diethylbutyl, 3,3-diethylbutyl and 1-methyl-1-propylbutyl. Examples of the C₃-C₈ alkoxy group represented by R¹ are n-propoxy, isopropoxy, n-butoxy, sec-butoxy, isobutoxy, tert-butoxy, n-pentyloxy, neopentyloxy, 2-methylbutoxy, 1-methylbutoxy, 1-ethylpropoxy, 1,1-dimethylpropoxy, n-hexyloxy, 1-methylpentyloxy, 2-methylpentyloxy, 3-methylpentyloxy, 4-methylpentyloxy, 3,3-dimethylbutoxy, 2,2-dimethoxybutoxy, 1,1-dimethylbutoxy, 2-ethylbutoxy, 1-ethylbutoxy, 1,3-dimethylbutoxy, n-pentyloxy, 5-methylhexyloxy, 4-methylhexyloxy, 3-methylhexyloxy, 2-methylhexyloxy, 1-methylhexyloxy, 3-ethylpentyloxy, 2-ethylpentyloxy, 1-ethylpentyloxy, 4,4-dimethylpentyloxy, 3,3-dimethylpentyloxy, 2,2-dimethylpentyloxy, 1,1-dimethylpentyloxy, n-octyloxy, 6-methylheptyloxy, 5-methylheptyloxy, 4-methylheptyloxy, 3-methylheptyloxy, 2-methylheptyloxy, 1-methylheptyloxy, 1-ethylhexyloxy, 1-propylpentyloxy, 3-ethylhexyloxy, 5,5-dimethylhexyloxy, 4,4-dimethylhexyloxy, 2,2-diethylbutoxy, 3,3-diethylbutoxy and 1-methyl-1-propylbutoxy. Examples of the alkoxyalkyl group having 3 to 8 carbon atoms represented by R¹ are ethoxymethyl, n-propoxymethyl, isopropoxymethyl, sec-butoxymethyl, isobutoxymethyl, (1-ethylpropoxy)methyl, (2-ethylbutoxy)methyl, (1-ethylbutoxy)methyl, (2-ethylpentyloxy)methyl, (3-ethylpentyloxy)methyl, 2-methoxyethyl, 1-methoxyethyl, 2-ethoxyethyl, 3-methoxypropyl, 2-methoxypropyl, 1-methoxypropyl, 2-ethoxypropyl, 3-(n-propoxy)propyl, 4-methoxybutyl, 2-methoxybutyl, 4-ethoxybutyl, 2-ethoxybutyl, 5-ethoxypentyl and 6-ethox-

yhexyl.

Examples of the C₃-C₈ alkenyl group represented by R¹ include 1-methylvinyl, allyl, 2-methylallyl, 1-propenyl, 1-methyl-1-propenyl, 2-methyl-1-propenyl, 1,1-dimethyl-2-propenyl, 2-butenyl, 3-butenyl, 3-methyl-2-butenyl, 2-methyl-2-butenyl, 2-methyl-3-butenyl, 1-pentenyl, 2-pentenyl, 1-hexenyl, 2-hexenyl, 5-hexenyl, 6-heptenyl and 7-octenyl. Examples of the C₃-C₈ alkenyloxy group represented by R¹ are allyloxy, 2-methylallyloxy, 1-propenyloxy, 2-methyl-1-propenyloxy, 2-butenyloxy, 3-butenyloxy, 3-methyl-2-butenyloxy, 2-methyl-2-butenyloxy, 2-methyl-3-butenyloxy, 2-pentenyl, 1-pentenyl, 1-hexenyloxy, 2-hexenyloxy, 5-hexenyloxy, 6-heptenyloxy and 7-octenyloxy. Examples of the alkenyloxyalkyl group having 3 to 8 carbon atoms represented by R¹ are allyloxymethyl, (2-methylallyloxy)methyl, (1-propenyloxy)methyl, (2-methyl-1-propenyloxy)methyl, (2-butenyloxy)methyl, (3-butenyloxy)methyl, (3-methyl-2-butenyloxy)methyl, (2-methyl-2-butenyloxy)methyl, (2-methyl-3-butenyloxy)methyl, (2-pentenyl)methyl, (1-pentenyl)methyl, (1-hexenyloxy)methyl, (2-hexenyloxy)methyl, (5-hexenyloxy)methyl, (6-heptenyloxy)methyl, 2-allyloxyethyl, 2-(2-methylallyloxy)ethyl, 2-(1-propenyloxy)ethyl, 2-(2-methyl-1-propenyloxy)ethyl, 2-(2-butenyloxy)ethyl, 2-(3-butenyloxy)ethyl, 2-(3-methyl-2-butenyloxy)ethyl, 2-(2-methyl-2-butenyloxy)ethyl, 2-(2-methyl-3-butenyloxy)ethyl, 2-(2-pentenyl)ethyl, 2-(1-pentenyl)ethyl, 2-(1-hexenyloxy)ethyl, 2-(2-hexenyloxy)ethyl, 2-(5-hexenyloxy)ethyl, 1-allyloxyethyl, 1-(2-methylallyloxy)ethyl, 1-(1-propenyloxy)ethyl, 1-(2-methyl-1-propenyloxy)ethyl, 1-(2-butenyloxy)ethyl, 1-(3-butenyloxy)ethyl, 1-(3-methyl-2-butenyloxy)ethyl, 1-(2-methyl-2-butenyloxy)ethyl, 1-(2-methyl-3-butenyloxy)ethyl, 1-(2-pentenyl)ethyl, 1-(1-pentenyl)ethyl, 1-(1-hexenyloxy)ethyl, 1-(2-hexenyloxy)ethyl and 1-(5-hexenyloxy)ethyl. Examples of the C₃-C₈ haloalkyl group represented by R¹ are 3-fluoropropyl, 2,2,3,3,3-pentafluoropropyl, 2-chloro-1-methylpropyl, 3-chloropropyl, 2-chloropropyl, 2,3-dichloropropyl, 3-bromopropyl, 2-bromopropyl, 3-iodopropyl, 4-fluorobutyl, 3,3,4,4,4-pentafluoro-2-butyl, 4-chlorobutyl, 3-chlorobutyl, 2,3,4-trichlorobutyl, 4-bromobutyl, 3-bromobutyl, 4-iodobutyl, 5-fluoropentyl, 5-chloropentyl, 5-bromopentyl, 6-fluorohexyl, 6-chlorohexyl, 6-bromohexyl, 7-fluoroheptyl, 7-bromoheptyl, 8-fluorooctyl and 8-bromooctyl. Examples of the C₃-C₈ haloalkoxy group represented by R¹ are 3-fluoropropoxy, 2,2,3,3,3-pentafluoropropoxy, 2-chloro-1-methylpropoxy, 3-chloropropoxy, 2-chloropropoxy, 2,3-dichloropropoxy, 3-bromopropoxy, 2-bromopropoxy, 3-iodopropoxy, 4-fluorobutoxy, 3,3,4,4,4-pentafluoro-2-butoxy, 4-chlorobutoxy, 3-chlorobutoxy, 2,3,4-trichlorobutoxy, 4-bromobutoxy, 3-bromobutoxy, 4-iodobutoxy, 5-fluoropentyloxy, 5-chloropentyloxy, 5-bromopentyloxy, 6-fluorohexyloxy, 6-chlorohexyloxy, 6-bromohexyloxy, 7-fluoroheptyloxy, 7-bromoheptyloxy, 8-fluorooctyloxy and 8-bromooctyloxy. Examples of the haloalkoxyalkyl group having 3 to 8 carbon atoms represented by R¹ are (3-fluoropropoxy)methyl, (2,2,3,3,3-pentafluoropropoxy)methyl, (2-chloro-1-methylpropoxy)methyl, (3-chloropropoxy)methyl, (2-chloropropoxy)methyl, (2,3-dichloropropoxy)methyl, (3-bromopropoxy)methyl, (2-bromopropoxy)methyl, (3-iodopropoxy)methyl, (4-fluorobutoxy)methyl, (3,3,4,4,4-pentafluoro-2-butoxy)methyl, (4-chlorobutoxy)methyl, (3-chlorobutoxy)methyl, (2,3,4-trichlorobutoxy)methyl, (4-bromobutoxy)methyl, (3-bromobutoxy)methyl, (4-iodobutoxy)methyl, (5-fluoropentyloxy)methyl, (5-chloropentyloxy)methyl, (5-bromopentyloxy)methyl, (6-fluorohexyloxy)methyl, (6-chlorohexyloxy)methyl, (6-bromohexyloxy)methyl, (7-fluoroheptyloxy)methyl, (7-bromoheptyloxy)methyl, 1-(3-fluoropropoxy)ethyl, 1-(2,2,3,3,3-pentafluoropropoxy)ethyl, 1-(2-chloro-1-methylpropoxy)ethyl, 1-(3-chloropropoxy)ethyl, 1-(2-chloropropoxy)ethyl, 1-(2,3-dichloropropoxy)ethyl, 1-(3-bromopropoxy)ethyl, 1-(2-bromopropoxy)ethyl, 1-(3-iodopropoxy)ethyl, 1-(4-fluorobutoxy)ethyl, 1-(3,3,4,4,4-pentafluoro-2-butoxy)ethyl, 1-(4-chlorobutoxy)ethyl, 1-(3-chlorobutoxy)ethyl, 1-(2,3,4-trichlorobutoxy)ethyl, 1-(4-bromobutoxy)ethyl, 1-(3-bromobutoxy)ethyl, 1-(4-iodobutoxy)ethyl, 1-(5-fluoropentyloxy)ethyl, 1-(5-chloropentyloxy)ethyl, 1-(5-bromopentyloxy)ethyl, 1-(6-fluorohexyloxy)ethyl, 1-(6-chlorohexyloxy)ethyl, 1-(6-bromohexyloxy)ethyl, 2-(3-fluoropropoxy)ethyl, 2-(2,2,3,3,3-pentafluoropropoxy)ethyl, 2-(2-chloro-1-methylpropoxy)ethyl, 2-(3-chloropropoxy)ethyl, 2-(2-chloropropoxy)ethyl, 2-(2,3-dichloropropoxy)ethyl, 2-(3-bromopropoxy)ethyl, 2-(2-bromopropoxy)ethyl, 2-(3-iodopropoxy)ethyl, 2-(4-fluorobutoxy)ethyl, 2-(3,3,4,4,4-pentafluoro-2-butoxy)ethyl, 2-(4-chlorobutoxy)ethyl, 2-(3-chlorobutoxy)ethyl, 2-(2,3,4-trichlorobutoxy)ethyl, 2-(4-bromobutoxy)ethyl, 2-(3-bromobutoxy)ethyl, 2-(4-iodobutoxy)ethyl, 2-(5-fluoropentyloxy)ethyl, 2-(5-chloropentyloxy)ethyl, 2-(5-bromopentyloxy)ethyl, 2-(6-fluorohexyloxy)ethyl, 2-(6-chlorohexyloxy)ethyl and 2-(6-bromohexyloxy)ethyl. Examples of the C₃-C₈ haloalkenyl group represented by R¹ include 2,3-dichloroallyl, 2,3-dibromoallyl, 2-chloro-2-propenyl, 3-chloro-2-propenyl, 2-bromo-2-propenyl, 2-chloromethyl-2-propenyl, 2-chloro-3-butenyl, 3-chloro-2-butenyl, 4-chloro-2-butenyl, 4-bromo-2-butenyl and 7-chloro-7-octenyl.

Examples of the C₃-C₈ haloalkenyloxy group represented by R¹ are 2,3-dichloroallyloxy, 2,3-dibromoallyloxy, 2-chloro-2-propenyloxy, 3-chloro-2-propenyloxy, 2-bromo-2-propenyloxy, 2-chloro-3-butenyloxy, 3-chloro-2-butenyloxy, 4-chloro-2-butenyloxy, 4-bromo-2-butenyloxy and 7-chloro-7-octenyloxy. Examples of the haloalkenyloxyalkyl group having 3 to 8 carbon atoms represented by R¹ are (2,3-dichloroallyloxy)methyl, (2,3-dibromoallyloxy)methyl, (2-chloro-2-propenyloxy)methyl, (3-chloro-2-propenyloxy)methyl, (2-bromo-2-propenyloxy)methyl, (2-chloro-3-butenyloxy)methyl, (3-chloro-2-butenyloxy)methyl, (4-chloro-2-

butenyl-oxy)methyl, (4-bromo-2-butenyloxy)methyl, (7-chloro-7-octenyloxy)methyl, 1-(2,3-dichloroallyloxy)-ethyl, 1-(2,3-dibromoallyloxy)ethyl, 1-(2-chloro-2-propenyloxy)ethyl, 1-(3-chloro-2-propenyloxy)ethyl, 1-(2-bromo-2-propenyloxy)ethyl, 1-(2-chloro-3-butenyloxy)ethyl, 1-(3-chloro-2-butenyloxy)ethyl, 1-(4-chloro-2-butenyloxy)ethyl, 1-(4-bromo-2-butenyloxy)ethyl, 1-(7-chloro-7-octenyloxy)ethyl, 2-(2,3-dichloroallyloxy)ethyl, 2-(2,3-dibromoallyloxy)ethyl, 2-(2-chloro-2-propenyloxy)ethyl, 2-(3-chloro-2-propenyloxy)ethyl, 2-(2-bromo-2-propenyloxy)ethyl, 2-(2-chloro-3-butenyloxy)ethyl, 2-(3-chloro-2-butenyloxy)ethyl, 2-(4-chloro-2-butenyloxy)-ethyl, 2-(4-bromo-2-butenyloxy)ethyl and 2-(7-chloro-7-octenyloxy)ethyl. Examples of the C₃-C₈ alkynyloxy group represented by R¹ are 2-propynyloxy, 1-methyl-2-propynyloxy, 1-ethyl-2-propynyloxy, 1-propyl-2-propynyloxy, 2-butyloxy, 1-ethyl-2-butyloxy, 1-propyl-2-butyloxy, 1-n-butyl-2-butyloxy, 2-pentynyloxy, 4-methyl-2-pentynyloxy, 1,4-dimethyl-2-pentynyloxy, 1-ethyl-4-methyl-2-pentynyloxy, 2-hexynyloxy, 3-hexynyloxy, 2-heptynyloxy, 2-octynyloxy and 7-octynyloxy. Examples of the halogen atom represented by R², R³ and R⁵ are fluorine, chlorine, bromine and iodine, among which preferred is chlorine. Examples of the C₁-C₄ alkyl group represented by R⁵ are methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl, isobutyl and tert-butyl, among which preferred is ethyl. Examples of the C₁-C₄ haloalkyl group represented by R⁵ include trifluoromethyl, difluoromethyl, 2-fluoroethyl, 1-fluoroethyl, 1,2-difluoroethyl, 2,2,2-trifluoroethyl, 2-chloroethyl, 3-fluoro-n-propyl, 2-fluoro-n-propyl, 1-fluoro-n-propyl, 3-chloro-n-propyl, 3-bromo-n-propyl, 4-fluoro-n-butyl and 4-chloro-n-butyl. Examples of the C₁-C₄ alkoxy group represented by R⁵ are methoxy, ethoxy, propoxy, isopropoxy, n-butoxy, tert-butoxy, isobutoxy and sec-butoxy. Example of the C₁-C₄ haloalkoxy group include trifluoromethoxy, difluoromethoxy, bromodifluoromethoxy, chlorodifluoromethoxy, 2-fluoroethoxy, 2,2,2-trifluoroethoxy, perfluoroethoxy, 1,1,2-trifluoroethoxy, 1-fluoroethoxy, 1,2-difluoroethoxy, 2-chloro-1,1,2-trifluoroethoxy, 3-fluoro-n-propoxy, 1-fluoro-n-propoxy, 2-fluoro-n-propoxy, perfluoro-n-propoxy, 4-fluoro-n-butoxy, 2-chloroethoxy, 3-chloro-n-propoxy, 4-chloro-n-butoxy, 3-bromo-n-propoxy, 1,1,2,2-tetrafluoroethoxy and 1,1-difluoromethoxy. Examples of the C₁-C₄ alkylthio group represented by R⁵ are methylthio, ethylthio, n-propylthio, isopropylthio, n-butylthio, isobutylthio, sec-butylthio and tert-butylthio. Examples of the C₁-C₄ haloalkylthio group represented by R⁵ are difluoromethylthio, trifluoromethylthio, 2-fluoroethylthio, 1-fluoroethylthio, 2-chloroethylthio, 1,2-difluoroethylthio, 2,2,2-trifluoroethylthio, 3-fluoropropylthio, 2-fluoropropylthio, 1-fluoropropylthio, 3-chloropropylthio, 3-bromopropylthio, 4-fluorobutylthio and 4-chlorobutylthio. Further, (R⁵)_n is preferably present at the 4-position.

The aromatic compounds (I) of the invention can be produced by various processes, among which typical examples are shown below.

Process A:-

The aromatic compound (I) is produced by reacting a phenol compound of the formula:



wherein M is an alkali metal atom or a hydrogen atom and R¹, R², R³ and m are each as defined above with a halide of the formula:



wherein A is a halogen atom and R⁴, R⁵ and n are each as defined above.

The reaction may be carried out usually in an inert solvent in the presence of a base at a temperature of from about -20 °C to the boiling point of the solvent, preferably from about -5 °C to the boiling point of

the solvent. When the phenol compound (II) is employed in a metal salt form, the base is not necessarily required to use.

The molar proportion of the phenol compound (II) and the halide (III) to be used for the reaction is not limitative but is preferred to be nearly equal. Examples of the inert solvent are lower alcohols (e.g. methanol, ethanol, propanol, isopropanol, tert-butyl alcohol), ketones (e.g. acetone, methyl ethyl ketone), hydrocarbons (e.g. hexane, benzene, toluene), ethers (e.g. diethyl ether, diisopropyl ether, tetrahydrofuran, dioxane), acid amides (e.g. N,N-dimethylformamide, hexamethylphosphoric triamide), halogenated hydrocarbons (e.g. dichloromethane, chloroform, 1,2-dichloroethane, chlorobenzene), nitriles (e.g. acetonitrile), nitro compounds (e.g. nitromethane), dimethyl sulfoxide, sulfolane, water and mixtures thereof. Example of the base are alkali metal hydroxides (e.g. sodium hydroxide, potassium hydroxide), alkali metal carbonates (e.g. sodium carbonate, potassium carbonate), alkali metals (e.g. metallic sodium), alkali metal hydrides (e.g. sodium hydride) and organic bases (e.g. sodium methoxide, sodium ethoxide, triethylamine, pyridine). When necessary or desired, an ammonium salt such as triethylbenzylammonium chloride and tetrabutylammonium bromide may be added to the reaction system as a catalyst.

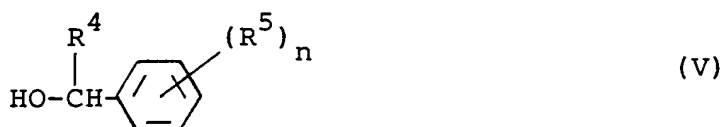
After completion of the reaction, post-treatment may follow in a per se conventional manner such as extraction with an organic solvent and concentration. When necessary or desired, the product may further be purified by chromatography, distillation, recrystallization, etc.

Process B:-

The aromatic compound (I) is produced by reacting a phenol compound of the formula:



wherein R^1 , R^2 , R^3 and m are each as defined above with an alcohol of the formula:



wherein R^4 , R^5 and n are each as defined above. This process is advantageously applicable when R^4 is other than a hydrogen atom.

The reaction may be carried out normally in an inert solvent in the presence of a dehydrating catalyst or agent at a temperature of from about -20 to 200°C or the boiling point of the inert solvent.

The molar proportion of the phenol compound (IV) and the alcohol (V) is not limitative but is preferred to be nearly equal. Examples of the dehydrating catalyst are inorganic acids (e.g. hydrochloric acid, sulfuric acid), aromatic sulfonic acids and sulfonic acid halides. Examples of the dehydrating agent include dicyclohexylcarbodiimide, diisopropyl azodicarboxylate with triphenylphosphine and diethyl azodicarboxylate with triphenylphosphine.

Examples of the inert solvent are hydrocarbons (e.g. benzene, toluene, xylene), ethers (e.g. diethyl ether, diisopropyl ether, tetrahydrofuran, dioxane) and halogenated hydrocarbons (e.g. carbon tetrachloride, dichloromethane, 1,2-dichloroethane, chlorobenzene, dichlorobenzene).

After completion of the reaction, post-treatment may follow in a per se conventional manner such as extraction with an organic solvent and concentration. When necessary or desired, the product may further be purified by e.g. chromatography, distillation or recrystallization.

The aromatic compounds (I) of the invention have some asymmetric carbon atoms and can form optical isomers. Those optical isomers and their mixtures fall within the scope of the invention.

Among the starting compounds in the above processes, the halide (III) and the alcohol (V) are available on the commercial market or can be readily produced from appropriate commercial products by the known method as described in Chem.Ber., 89, 1732 (1956), J.Amer.Chem.Soc., 76, 908 (1954), etc.

Among the starting compounds in the above processes, the phenol compound (II) wherein M is an alkali metal atom can be prepared from the corresponding phenol compound (IV) (i.e. the compound of the formula (II) wherein M is a hydrogen atom).

The phenol compound (IV) are available on the commercial market or can be readily produced from appropriate commercial products by conventional method.

The phenol compound (II) or (IV) wherein R^2 is a chlorine atom can be also prepared by the known method as described in J.Amer.Chem.Soc., 73, 2723 (1951), J.Org.Chem., 39, 1160 (1974), etc. Furthermore, the phenol compound (IV) may be prepared by reacting the corresponding non-chlorinated compound, i.e. a phenol compound, of the formula:

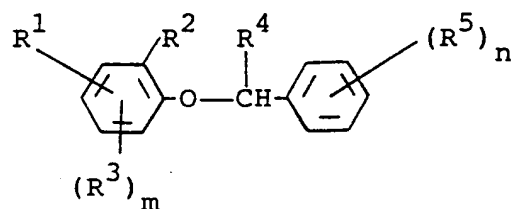


wherein R^1 , R^3 and m are each as defined above with a chlorinating agent, preferably in an inert solvent.

The molar proportion of the phenol compound (VI) and the chlorinating agent is not limitative but it is ordinary to use the chlorinating agent in an amount equivalent to the phenol compound (VI) or somewhat in excess. Examples of the chlorinating agent are chlorine, tert-butyl hypochlorite and suluryl chloride. If necessary and desired, the reaction can be carried out in the presence of an inert solvent. Examples of the solvent are dichloromethane, 1,2-dichloroethane, carbon tetrachloride, benzene and acetic acid. The chlorinating agent itself may be available as a reaction medium when it is liquid. The reaction temperature is usually from about -80°C to the refluxing temperature of the reaction system, preferably from about -20°C to the refluxing temperature of the reaction system.

After completion of the reaction, post-treatment may follow in a per se conventional manner such as extraction with an organic solvent and concentration. When necessary or desired, the product may further be purified by chromatography, distillation, recrystallization, etc.

Examples of the aromatic compounds (I) of the present invention are shown in Table 1.

Table 1

R^1	R^2	$(R^3)_m$	R^4	$(R^5)_n$
4-O-sec-C ₄ H ₉	Cl	H	H	4-Cl
4-O-sec-C ₄ H ₉	Cl	H	H	4-Br
4-O-sec-C ₄ H ₉	Cl	H	H	4-F
4-O-sec-C ₄ H ₉	Cl	H	H	3,4-F ₂
4-O-sec-C ₄ H ₉	Cl	H	H	4-I
4-O-sec-C ₄ H ₉	Cl	H	H	3,4-Cl ₂
4-O-sec-C ₄ H ₉	Cl	H	H	2,3,4,5,6-F ₅
4-O-sec-C ₄ H ₉	Cl	H	H	3,5-F ₂
4-O-sec-C ₄ H ₉	Cl	H	H	4-CH ₃
4-O-sec-C ₄ H ₉	Cl	H	H	4-C ₂ H ₅
4-O-sec-C ₄ H ₉	Cl	H	H	4-n-C ₃ H ₇
4-O-sec-C ₄ H ₉	Cl	H	H	4-iso-C ₃ H ₇
4-O-sec-C ₄ H ₉	Cl	H	H	4-n-C ₄ H ₉
4-O-sec-C ₄ H ₉	Cl	H	H	4-sec-C ₄ H ₉
4-O-sec-C ₄ H ₉	Cl	H	H	4-tert-C ₄ H ₉
4-O-sec-C ₄ H ₉	Cl	H	H	4-iso-C ₄ H ₉
4-O-sec-C ₄ H ₉	Cl	H	H	4-OCH ₃
4-O-sec-C ₄ H ₉	Cl	H	H	4-OC ₂ H ₅
4-O-sec-C ₄ H ₉	Cl	H	H	4-O-n-C ₃ H ₇

	<u>R¹</u>	<u>R²</u>	<u>(R³)_m</u>	<u>R⁴</u>	<u>(R⁵)_n</u>
5	4-O-sec-C ₄ H ₉	Cl	H	H	4-O-iso-C ₃ H ₇
	4-O-sec-C ₄ H ₉	Cl	H	H	4-O-n-C ₄ H ₉
	4-O-sec-C ₄ H ₉	Cl	H	H	4-O-sec-C ₄ H ₉
10	4-O-sec-C ₄ H ₉	Cl	H	H	4-O-tert-C ₄ H ₉
	4-O-sec-C ₄ H ₉	Cl	H	H	4-CH ₂ CH ₂ F
	4-O-sec-C ₄ H ₉	Cl	H	H	4-CF ₃
15	4-O-sec-C ₄ H ₉	Cl	H	H	4-CF ₂ H
	4-O-sec-C ₄ H ₉	Cl	H	H	4-CF ₂ CF ₃
	4-O-sec-C ₄ H ₉	Cl	H	H	4-CHFCH ₂ F
20	4-O-sec-C ₄ H ₉	Cl	H	H	4(CH ₂) ₃ F
	4-O-sec-C ₄ H ₉	Cl	H	H	4-(CH ₂) ₄ F
	4-O-sec-C ₄ H ₉	Cl	H	H	4-OCF ₂ H
25	4-O-sec-C ₄ H ₉	Cl	H	H	4-OCF ₂ CF ₂ H
	4-O-sec-C ₄ H ₉	Cl	H	H	4-SCF ₂ H
30	4-O-sec-C ₄ H ₉	Cl	H	H	4-SCF ₂ CF ₂ H
	4-O-sec-C ₄ H ₉	Cl	H	H	4-SCH ₃
	4-O-sec-C ₄ H ₉	Cl	H	H	4-SC ₂ H ₅
35	4-O-sec-C ₄ H ₉	Cl	H	H	4-S-n-C ₃ H ₇
	4-O-sec-C ₄ H ₉	Cl	H	H	4-S-iso-C ₃ H ₇
	4-O-sec-C ₄ H ₉	Cl	H	H	4-S-n-C ₄ H ₉
40	4-O-sec-C ₄ H ₉	Cl	H	H	4-S-sec-C ₄ H ₉
	4-O-sec-C ₄ H ₉	Cl	H	H	3,4-OCH ₂ O-
	4-O-sec-C ₄ H ₉	Cl	H	H	4-CH ₂ OCH ₃
45	4-O-sec-C ₄ H ₉	Cl	H	H	4-CN

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	<u>R¹</u>	<u>R²</u>	<u>(R³)_m</u>	<u>R⁴</u>	<u>(R⁵)_n</u>
5	4-O-sec-C ₄ H ₉	Cl	H	H	4-NO ₂
	4-O-sec-C ₄ H ₉	Cl	H	H	2,4-(CH ₃) ₂
	4-O-sec-C ₄ H ₉	Cl	H	H	2,5-(CH ₃) ₂
10	4-O-sec-C ₄ H ₉	Cl	H	H	3,4-(CH ₃) ₂
	4-O-sec-C ₄ H ₉	Cl	H	H	3,5-(CH ₃) ₂
	4-O-sec-C ₄ H ₉	Cl	H	H	H
15	4-O-sec-C ₄ H ₉	Cl	H	H	2-CH ₃
	4-O-sec-C ₄ H ₉	Cl	H	H	3-CH ₃
	4-O-sec-C ₄ H ₉	Cl	H	H	4-C ₂ H ₅
20	4-O-sec-C ₄ H ₉	Br	H	H	4-Cl
	4-O-sec-C ₄ H ₉	F	H	H	4-Cl
	4-O-sec-C ₄ H ₉	I	H	H	4-Cl
25	4-O-sec-C ₄ H ₉	Cl	5-Cl	H	4-Cl
	4-O-sec-C ₄ H ₉	Cl	3-Cl	H	4-Cl
30	4-O-sec-C ₄ H ₉	Cl	H	CH ₃	4-Cl
	4-O-sec-C ₄ H ₉	Cl	5-F	H	4-Cl
	4-O-sec-C ₄ H ₉	Cl	5-F	H	4-C ₂ H ₅
35	4-O-sec-C ₄ H ₉	Cl	5-CH ₃	H	4-Cl
	4-O-sec-C ₄ H ₉	Cl	5-CH ₃	H	4-C ₂ H ₅
	4-O-sec-C ₄ H ₉	Cl	3,5-F ₂	H	4-Cl
40	4-O-sec-C ₄ H ₉	Cl	3,5-F ₂	H	4-C ₂ H ₅
	4-O-sec-C ₄ H ₉	Cl	3,5-Cl ₂	H	4-Cl
	4-O-sec-C ₄ H ₉	Cl	3,5-Cl ₂	H	4-C ₂ H ₅
45	4-CH ₂ CH(C ₂ H ₅) ₂	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	4-CH ₂ CH(C ₂ H ₅) ₂	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ OCH ₂ CH(CH ₃) ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH(CH ₃) ₂	Cl	H	H	4-C ₂ H ₅
10	4-OCH ₂ C(CH ₃)=CH ₂	Cl	H	H	4-Cl
	4-OCH ₂ CH=CH ₂	Cl	H	H	4-Cl
	4-OCH ₂ CH=CH ₂	Cl	H	H	4-C ₂ H ₅
15	4-OCH ₂ CH=CH(CH ₃)	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ Cl	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ Cl	Cl	H	H	4-C ₂ H ₅
20	4-O(CH ₂) ₃ Br	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ Br	Cl	H	H	4-C ₂ H ₅
25	4-OCH ₂ C≡CH	Cl	H	H	4-Cl
	4-OCH ₂ C≡CH	Cl	H	H	4-C ₂ H ₅
	4-OCH ₂ C≡CCH ₃	Cl	H	H	4-Cl
30	4-OCH(C ₂ H ₅) ₂	Cl	H	CH ₃	4-Cl
	4-OCH(C ₂ H ₅) ₂	Cl	H	CH ₃	4-C ₂ H ₅
	4-(CH ₂) ₃ CH(CH ₃) ₂	Cl	H	H	4-Cl
35	4-(CH ₂) ₃ CH(CH ₃) ₂	Cl	H	H	4-C ₂ H ₅
	4-sec-C ₄ H ₉	Cl	H	H	4-Cl
	4-sec-C ₄ H ₉	Cl	H	H	4-C ₂ H ₅
40	4-C(CH ₃) ₂ C ₂ H ₅	Cl	H	H	4-Cl
	4-C ₆ H ₁₃	Cl	H	H	4-Cl
45	4-CH(CH ₃)(CH ₂) ₄ H	Cl	H	H	4-Cl
	4-CH ₂ CH(CH ₃)(CH ₂) ₃ H	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	$4-C_2H_4CH(CH_3)C_2H_5$	C1	H	H	4-C1
	$4-(CH_2)_3CH(CH_3)_2$	C1	H	H	4-C1
	$4-C_2H_4C(CH_3)_3$	C1	H	H	4-C1
10	$4-C_2H_4C(CH_3)_3$	C1	H	H	4-C ₂ H ₅
	$4-C(CH_3)_2C_3H_7$	C1	H	H	4-C1
	$4-C(CH_3)_2C_3H_7$	C1	H	H	4-C ₂ H ₅
15	$4-CH_2C(CH_3)_2C_2H_5$	C1	H	H	4-C1
	$4-CH_2CH(C_2H_5)_2$	C1	H	H	4-C1
	$4-CH(C_2H_5)C_3H_7$	C1	H	H	4-C1
20	$4-CH(CH_3)CH_2CH(CH_3)_2$	C1	H	H	4-C1
	$4-C_7H_{15}$	C1	H	H	4-C1
25	$4-(CH_2)_4CH(CH_3)_2$	C1	H	H	4-C1
	$4-(CH_2)_3CH(CH_3)C_2H_5$	C1	H	H	4-C1
	$4-C_2H_4CH(CH_3)C_3H_7$	C1	H	H	4-C1
30	$4-CH_2CH(CH_3)C_4H_9$	C1	H	H	4-C1
	$4-CH_2CH(CH_3)C_4H_9$	C1	H	H	4-C ₂ H ₅
	$4-CH(CH_3)C_5H_{11}$	C1	H	H	4-C1
35	$4-CH(CH_3)C_5H_{11}$	C1	H	H	4-C ₂ H ₅
	$4-C_2H_4CH(C_2H_5)_2$	C1	H	H	4-C1
	$4-CH_2CH(C_2H_5)C_3H_7$	C1	H	H	4-C1
40	$4-CH(C_2H_5)C_4H_9$	C1	H	H	4-C1
	$4-CH(C_2H_5)C_4H_9$	C1	H	H	4-C ₂ H ₅
45	$4-(CH_2)C(CH_3)_3$	C1	H	H	4-C1
	$4-C_2H_4C(CH_3)_2C_2H_5$	C1	H	H	4-C1

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	4-CH ₂ C(CH ₃) ₂ C ₃ H ₇	Cl	H	H	4-Cl
	4-C(CH ₃) ₂ C ₄ H ₉	Cl	H	H	4-Cl
	4-(CH ₂) ₅ CH(CH ₃) ₂	Cl	H	H	4-Cl
10	4-(CH ₂) ₅ CH(CH ₃) ₂	Cl	H	H	4-C ₂ H ₅
	4-(CH ₂) ₄ CH(CH ₃)C ₂ H ₅	Cl	H	H	4-Cl
	4-(CH ₂) ₃ CH(CH ₃)C ₃ H ₇	Cl	H	H	4-Cl
15	4-(CH ₂) ₃ CH(CH ₃)C ₃ H ₇	Cl	H	H	4-C ₂ H ₅
	4-C ₂ H ₄ CH(CH ₃)C ₄ H ₉	Cl	H	H	4-Cl
	4-CH ₂ CH(CH ₃)C ₅ H ₁₁	Cl	H	H	4-Cl
20	4-CH(CH ₃)C ₆ H ₁₃	Cl	H	H	4-Cl
	4-CH(CH ₃)C ₆ H ₁₃	Cl	H	H	4-C ₂ H ₅
25	4-CH(C ₂ H ₅)C ₅ H ₁₁	Cl	H	H	4-Cl
	4-CH(C ₂ H ₅)C ₅ H ₁₁	Cl	H	H	4-C ₂ H ₅
	4-C ₈ H ₁₇	Cl	H	H	4-Cl
30	4-C ₈ H ₁₇	Cl	H	H	4-C ₂ H ₅
	4-(CH ₂) ₄ C(CH ₃) ₃	Cl	H	H	4-Cl
	4-(CH ₂) ₃ C(CH ₃) ₂ C ₂ H ₅	Cl	H	H	4-Cl
35	4-CH ₂ C(C ₂ H ₅) ₃	Cl	H	H	4-Cl
	4-C ₂ H ₄ C(C ₂ H ₅) ₂ CH ₃	Cl	H	H	4-Cl
	4-OC ₃ H ₇	Cl	H	H	4-Cl
40	4-OC ₃ H ₇	Cl	H	H	4-C ₂ H ₅
	4-OC ₄ H ₉	Cl	H	H	4-Cl
45	4-O-iso-C ₄ H ₉	Cl	H	H	4-Cl
	4-O-iso-C ₄ H ₉	Cl	H	H	4-C ₂ H ₅

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	4-O-tert-C ₄ H ₉	Cl	H	H	4-Cl
	4-OC ₈ H ₁₇	Cl	H	H	4-Cl
	4-OC ₈ H ₁₇	Cl	H	H	4-C ₂ H ₅
10	4-OCH ₂ CH(C ₂ H ₅) CH ₃	Cl	H	H	4-Cl
15	4-OCH(C ₃ H ₇) CH ₃	Cl	H	H	4-Cl
	4-OCH(C ₃ H ₇) CH ₃	Cl	H	H	4-C ₂ H ₅
20	4-OCH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
	4-OC(CH ₃) ₂ C ₂ H ₅	Cl	H	H	4-Cl
25	4-OC(CH ₃) ₂ C ₂ H ₅	Cl	H	H	4-C ₂ H ₅
	4-OCH(CH ₃)C ₄ H ₉	Cl	H	H	4-Cl
	4-OCH(CH ₃)C ₄ H ₉	Cl	H	H	4-C ₂ H ₅
30	4-OCH ₂ CH(CH ₃)C ₃ H ₇	Cl	H	H	4-Cl
	4-OC ₂ H ₄ CH(CH ₃)C ₂ H ₅	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ CH(CH ₃) ₂	Cl	H	H	4-Cl
35	4-OC ₂ H ₄ C(CH ₃) ₃	Cl	H	H	4-Cl
	4-OCH ₂ C(CH ₃) ₂ C ₂ H ₅	Cl	H	H	4-Cl
40	4-OCH ₂ CH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
	4-OCH(C ₂ H ₅)C ₃ H ₇	Cl	H	H	4-Cl
	4-OCH(CH ₃)CH ₂ CH(CH ₃) ₂	Cl	H	H	4-Cl
45	4-OCH(CH ₃)CH ₂ CH(CH ₃) ₂	Cl	H	H	4-C ₂ H ₅
	4-OC ₇ H ₁₅	Cl	H	H	4-Cl

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	<u>R¹</u>	<u>R²</u>	<u>(R³)_m</u>	<u>R⁴</u>	<u>(R⁵)_n</u>
5	4-O(CH ₂) ₄ CH(CH ₃)CH ₃	Cl	H	H	4-Cl
	4-O(CH ₂) ₄ CH(CH ₃)CH ₃	Cl	H	H	4-C ₂ H ₅
	4-O(CH ₂) ₃ CH(CH ₃)C ₂ H ₅	Cl	H	H	4-Cl
10	4-O(CH ₂) ₃ CH(CH ₃)C ₂ H ₅	Cl	H	H	4-C ₂ H ₅
	4-O(CH ₂) ₃ CH(CH ₃)C ₃ H ₇	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ CH(CH ₃)C ₃ H ₇	Cl	H	H	4-C ₂ H ₅
15	4-OCH ₂ CH(CH ₃)C ₄ H ₉	Cl	H	H	4-Cl
	4-OCH(CH ₃)C ₅ H ₁₁	Cl	H	H	4-Cl
	4-OCH(CH ₃)C ₅ H ₁₁	Cl	H	H	4-C ₂ H ₅
20	4-OC ₂ H ₄ CH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
	4-OCH ₂ CH(C ₂ H ₅)C ₃ H ₇	Cl	H	H	4-Cl
	4-OCH(C ₂ H ₅)C ₄ H ₉	Cl	H	H	4-Cl
25	4-OCH(C ₂ H ₅)C ₄ H ₉	Cl	H	H	4-C ₂ H ₅
	4-O(CH ₂) ₃ C(CH ₃) ₃	Cl	H	H	4-Cl
	4-OCH ₂ C(CH ₃) ₂ C ₃ H ₇	Cl	H	H	4-Cl
30	4-O(CH ₂) ₅ CH(CH ₃) ₂	Cl	H	H	4-Cl
	4-O(CH ₂) ₄ CH(CH ₃)C ₂ H ₅	Cl	H	H	4-Cl
35	4-OCH(CH ₃)C ₆ H ₁₃	Cl	H	H	4-Cl
	4-OCH(CH ₃)C ₆ H ₁₃	Cl	H	H	4-C ₂ H ₅
	4-OC ₂ H ₄ CH(C ₂ H ₅)C ₃ H ₇	Cl	H	H	4-Cl
40	4-O(CH ₂) ₄ C(CH ₃) ₂	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ C(CH ₃) ₂ C ₂ H ₅	Cl	H	H	4-Cl
	4-OCH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
45	4-OC ₂ H ₄ C(C ₂ H ₅) ₂ CH ₃	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	4-CH ₂ OC ₂ H ₅	Cl	H	H	4-Cl
	4-C ₂ H ₄ OCH ₃	Cl	H	H	4-Cl
	4-C ₂ H ₄ OCH ₃	Cl	H	H	4-C ₂ H ₅
10	4-CH(CH ₃)OCH ₃	Cl	H	H	4-Cl
	4-CH(CH ₃)OCH ₃	Cl	H	H	4-C ₂ H ₅
	4-C ₂ H ₄ OC ₂ H ₅	Cl	H	H	4-Cl
15	4-CH ₂ OC ₂ H ₅	Cl	H	H	4-C ₂ H ₅
	4-(CH ₂) ₃ OCH ₃	Cl	H	H	4-Cl
	4-CH ₂ CH(CH ₃)OCH ₃	Cl	H	H	4-Cl
20	4-CH ₂ CH(CH ₃)OC ₂ H ₅	Cl	H	H	4-Cl
	4-CH ₂ CH(OCH ₃)C ₂ H ₅	Cl	H	H	4-Cl
25	4-CH ₂ CH(OC ₂ H ₅)C ₂ H ₅	Cl	H	H	4-Cl
	4-(CH ₂) ₄ OCH ₃	Cl	H	H	4-Cl
	4-CH(OCH ₃)C ₂ H ₅	Cl	H	H	4-Cl
30	4-CH ₂ OC ₃ H ₇	Cl	H	H	4-Cl
	4-CH ₂ OCH(CH ₃) ₂	Cl	H	H	4-Cl
	4-(CH ₂) ₃ OC ₃ H ₇	Cl	H	H	4-Cl
35	4-(CH ₂) ₄ OC ₃ H ₇	Cl	H	H	4-Cl
	4-(CH ₂) ₆ OC ₂ H ₅	Cl	H	H	4-Cl
	4-(CH ₂) ₆ OC ₂ H ₅	Cl	H	H	4-C ₂ H ₅
40	4-(CH ₂) ₅ OC ₂ H ₅	Cl	H	H	4-Cl
	4-(CH ₂) ₄ OC ₂ H ₅	Cl	H	H	4-Cl
45	4-CH ₂ OCH(CH ₃)C ₂ H ₅	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH(CH ₃) ₂	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)}_m$	$\underline{R^4}$	$\underline{(R^5)}_n$
5	4-CH ₂ OCH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ $\underset{\begin{array}{c} \\ C_3H_7 \end{array}}{CH}C_2H_5$	Cl	H	H	4-Cl
10					
	4-CH ₂ OCH ₂ CH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
	4-CH ₂ OC ₂ H ₄ CH(C ₂ H ₅) ₂	Cl	H	H	4-Cl
15	4-CH ₂ CH=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ CH=CH ₂	Cl	H	H	4-C ₂ H ₅
	4-CH=CHCH ₃	Cl	H	H	4-Cl
20	4-CH ₂ CH=CHCH ₃	Cl	H	H	4-Cl
	4-CH ₂ C(CH ₃)=CH ₂	Cl	H	H	4-Cl
25	4-CH ₂ CH=CHC ₂ H ₅	Cl	H	H	4-Cl
	4-CH ₂ CH=C(CH ₃) ₂	Cl	H	H	4-Cl
	4-CH=CH-tert-C ₄ H ₉	Cl	H	H	4-Cl
30	4-CH ₂ C(CH ₃)=CHCH ₃	Cl	H	H	4-Cl
	4-CH=CHC ₃ H ₇	Cl	H	H	4-Cl
	4-CH=CHC ₄ H ₉	Cl	H	H	4-Cl
35	4-CH ₂ CH=CHC ₃ H ₇	Cl	H	H	4-Cl
	4-(CH ₂) ₄ CH=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ CH(CH ₃)CH=CH ₂	Cl	H	H	4-Cl
40	4-C(CH ₃) ₂ CH=CH ₂	Cl	H	H	4-Cl
	4-(CH ₂) ₅ CH=CH ₂	Cl	H	H	4-Cl
45	4-(CH ₂) ₆ CH=CH ₂	Cl	H	H	4-Cl
	4-(CH ₂) ₆ CH=CH ₂	Cl	H	H	4-C ₂ H ₅

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)}_m$	$\underline{R^4}$	$\underline{(R^5)}_n$
5	4-OCH ₂ CH=CH ₂	Cl	H	H	4-Cl
	4-OCH ₂ CH=CH ₂	Cl	H	H	4-C ₂ H ₅
	4-OCH=CHCH ₃	Cl	H	H	4-Cl
10	4-OCH ₂ CH=CHCH ₃	Cl	H	H	4-Cl
	4-OCH ₂ C(CH ₃)=CH ₂	Cl	H	H	4-Cl
	4-OCH ₂ CH=CHC ₂ H ₅	Cl	H	H	4-Cl
15	4-OCH ₂ CH=CHC ₂ H ₅	Cl	H	H	4-C ₂ H ₅
	4-OCH ₂ CH=C(CH ₃) ₂	Cl	H	H	4-Cl
20	4-OCH ₂ C(CH ₃)=CHCH ₃	Cl	H	H	4-Cl
	4-OCH ₂ CH=CHC ₃ H ₇	Cl	H	H	4-Cl
	4-O(CH ₂) ₄ CH=CH ₂	Cl	H	H	4-Cl
25	4-OCH ₂ CH(CH ₃)CH=CH ₂	Cl	H	H	4-Cl
	4-O(CH ₂) ₅ CH=CH ₂	Cl	H	H	4-Cl
	4-O(CH ₂) ₆ CH=CH ₂	Cl	H	H	4-Cl
30	4-O(CH ₂) ₆ CH=CH ₂	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ OCH ₂ CH=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH=CH ₂	Cl	H	H	4-C ₂ H ₅
35	4-CH ₂ OCH=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH=CHCH ₂	Cl	H	H	4-Cl
40	4-CH ₂ OC ₂ H ₄ CH=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ C(CH ₃)=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH=CHC ₂ H ₅	Cl	H	H	4-Cl
45	4-CH ₂ OCH ₂ CH=CHC ₂ H ₅	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ OCH ₂ C=CH(CH ₃) ₂	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	$4-\text{CH}_2\text{OCH}_2\underset{\text{CH}_3}{\text{C}}=\text{CHCH}_3$	C1	H	H	4-C1
	$4-\text{CH}_2\text{OCH}_2\text{CH}=\text{CH}(\text{C}_3\text{H}_7)$	C1	H	H	4-C1
10	$4-\text{CH}_2\text{O}(\text{CH}_2)_4\text{CH}=\text{CH}_2$	C1	H	H	4-C1
	$4-\text{CH}_2\text{OCH}_2\underset{\text{CH}_3}{\text{CH}}\text{CH}=\text{CH}_2$	C1	H	H	4-C1
15	$4-\text{CH}_2\text{O}(\text{CH}_2)_5\text{CH}=\text{CH}_2$	C1	H	H	4-C1
	$4-\text{C}_2\text{H}_4\text{OCH}_2\text{CH}=\text{CH}_2$	C1	H	H	4-C1
	$4-\text{C}_2\text{H}_4\text{OCH}_2\text{CH}=\text{CH}(\text{CH}_3)$	C1	H	H	4-C1
20	$4-\text{C}_2\text{H}_4\text{OC}_2\text{H}_4\text{CHCH}_2$	C1	H	H	4-C1
	$4-\text{C}_2\text{H}_4\text{OCH}_2\underset{\text{CH}_3}{\text{C}}=\text{CH}_2$	C1	H	H	4-C1
25	$4-\text{C}_2\text{H}_4\text{OCH}_2\text{CH}=\text{CHC}_2\text{H}_5$	C1	H	H	4-C1
	$4-\text{C}_2\text{H}_4\text{OCH}_2\text{CH}=\text{C}(\text{CH}_3)_2$	C1	H	H	4-C1
30	$4-\text{C}_2\text{H}_4\text{OCH}_2\underset{\text{CH}_3}{\text{C}}=\text{CHCH}_3$	C1	H	H	4-C1
	$4-\text{C}_2\text{H}_4\text{OCH}_2\underset{\text{CH}_3}{\text{C}}=\text{CHCH}_3$	C1	H	H	4-C ₂ H ₅
35	$4-\text{C}_2\text{H}_4\text{OCH}_2\underset{\text{HC}=\text{CHC}_3\text{H}_7}{\text{C}}=\text{CH}_2$	C1	H	H	4-C1
40	$4-\text{C}_2\text{H}_4\text{OCH}_2\underset{\text{HC}=\text{CHC}_3\text{H}_7}{\text{C}}=\text{CH}_2$	C1	H	H	4-C ₂ H ₅
45	$4-\text{C}_2\text{H}_4\text{O}(\text{CH}_2)_4\text{CH}=\text{CH}_2$	C1	H	H	4-C1
	$4-\text{C}_2\text{H}_4\text{O}(\text{CH}_2)_4\text{CH}=\text{CH}_2$	C1	H	H	4-C ₂ H ₅

	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	$4-C_2H_4OCH_2\underset{\substack{ \\ HC=CH_2}}{CH}CH_3$	Cl	H	H	4-Cl
10	$4-C_2H_4OCH_2\underset{\substack{ \\ HC=CH_2}}{CH}CH_3$	Cl	H	H	4-C ₂ H ₅
15	$4-CHOCH_2CH=CH_2$ $\quad \quad \quad $ $\quad \quad \quad CH_3$	Cl	H	H	4-Cl
20	$4-CHOCH_2CH=CH_2$ $\quad \quad \quad $ $\quad \quad \quad CH_3$	Cl	H	H	4-C ₂ H ₅
25	$4-CHOCH_2CH=CHCH_3$ $\quad \quad \quad $ $\quad \quad \quad CH_3$	Cl	H	H	4-Cl
30	$4-CHOCH_2CH=CH$ $\quad \quad \quad \quad \quad \quad $ $\quad \quad \quad CH_3 \quad \quad CH_2CH_3$	Cl	H	H	4-Cl
35	$4-CHOCH_2CH=C(CH_3)_2$ $\quad \quad \quad $ $\quad \quad \quad CH_3$	Cl	H	H	4-Cl
40	$4-CHOCH_2C=CHCH_3$ $\quad \quad \quad \quad \quad \quad $ $\quad \quad \quad CH_3 \quad \quad CH_3$	Cl	H	H	4-Cl
45	$4-CHOCH_2CH=CHC_3H_7$ $\quad \quad \quad $ $\quad \quad \quad CH_3$	Cl	H	H	4-Cl
50	$4-CHO(CH_2)_4CH=CH_2$ $\quad \quad \quad $ $\quad \quad \quad CH_3$	Cl	H	H	4-Cl
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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	4- $\underset{\text{CH}_3}{\text{CHO}}(\text{CH}_2)_4\text{CH}=\text{CH}_2$	Cl	H	H	4-C ₂ H ₅
10	4- $\underset{\text{CH}_3}{\text{CHOCH}_2}\underset{\text{CH}_3}{\text{CH}}\text{CH}=\text{CH}_2$	Cl	H	H	4-Cl
	4-(CH ₂) ₃ Br	Cl	H	H	4-Cl
	4-(CH ₂) ₃ Br	Cl	H	H	4-C ₂ H ₅
15	4-(CH ₂) ₃ Cl	Cl	H	H	4-Cl
	4-(CH ₂) ₃ Cl	Cl	H	H	4-C ₂ H ₅
	4-(CH ₂) ₄ Cl	Cl	H	H	4-Cl
20	4-(CH ₂) ₅ Cl	Cl	H	H	4-Cl
	4-(CH ₂) ₅ Cl	Cl	H	H	4-C ₂ H ₅
25	4-(CH ₂) ₆ Cl	Cl	H	H	4-Cl
	4-(CH ₂) ₇ Br	Cl	H	H	4-Cl
	4-(CH ₂) ₈ Br	Cl	H	H	4-Cl
30	4-(CH ₂) ₈ Br	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ CH(Cl)CH ₃	Cl	H	H	4-Cl
	4-CH(CH ₃)CH(Cl)CH ₃	Cl	H	H	4-Cl
35	4-C ₂ H ₄ CH(Cl)CH ₃	Cl	H	H	4-Cl
	4-CH ₂ CH(Cl)CH ₃	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ CH(Cl)CH ₂ Cl	Cl	H	H	4-Cl
40	4-CH ₂ CF ₂ CF ₃	Cl	H	H	4-Cl
	4-CH ₂ CF ₂ CF ₃	Cl	H	H	4-C ₂ H ₅
45	4-CH(CH ₃)CF ₂ CF ₃	Cl	H	H	4-Cl
	4-(CH ₂) ₃ F	Cl	H	H	4-Cl

	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	4-(CH ₂) ₃ F	Cl	H	H	4-C ₂ H ₅
	4-(CH ₂) ₄ F	Cl	H	H	4-Cl
	4-(CH ₂) ₅ F	Cl	H	H	4-Cl
10	4-O(CH ₂) ₃ Br	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ Cl	Cl	H	H	4-Cl
	4-O(CH ₂) ₄ Cl	Cl	H	H	4-Cl
15	4-O(CH ₂) ₄ Br	Cl	H	H	4-Cl
	4-O(CH ₂) ₅ Cl	Cl	H	H	4-Cl
	4-O(CH ₂) ₅ Cl	Cl	H	H	4-C ₂ H ₅
20	4-O(CH ₂) ₆ Cl	Cl	H	H	4-Cl
	4-O(CH ₂) ₇ Br	Cl	H	H	4-Cl
	4-O(CH ₂) ₈ Br	Cl	H	H	4-Cl
25	4-O(CH ₂) ₈ Br	Cl	H	H	4-C ₂ H ₅
	4-OCH ₂ CH(Cl)CH ₃	Cl	H	H	4-Cl
30	4-OCH ₂ CH(Cl)CH ₃	Cl	H	H	4-C ₂ H ₅
	4-OCH(CH ₃)CH(Cl)CH ₃	Cl	H	H	4-Cl
	4-OCH ₂ CH(Br)CH ₃	Cl	H	H	4-Cl
35	4-OC ₂ H ₄ CH(Cl)CH ₃	Cl	H	H	4-Cl
	4-OC ₂ H ₄ CH(Br)CH ₃	Cl	H	H	4-Cl
	4-OCH ₂ CH(Cl)CH ₂ Cl	Cl	H	H	4-Cl
40	4-OCH ₂ (CHCl) ₂ CH ₂ Cl	Cl	H	H	4-Cl
	4-OCH ₂ CF ₂ CF ₃	Cl	H	H	4-Cl
	4-OCH ₂ CF ₂ CF ₃	Cl	H	H	4-C ₂ H ₅
45	4-OCH(CH ₃)CF ₂ CF ₃	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)}_m$	$\underline{R^4}$	$\underline{(R^5)}_n$
5	4-OC ₂ H ₄ CH ₂ F	Cl	H	H	4-Cl
	4-O(CH ₂) ₃ CH ₂ F	Cl	H	H	4-Cl
	4-O(CH ₂) ₄ CH ₂ F	Cl	H	H	4-Cl
10	4-CH ₂ OC ₂ H ₄ Br	Cl	H	H	4-Cl
	4-CH ₂ OC ₂ H ₄ Br	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ O(CH ₂) ₃ Cl	Cl	H	H	4-Cl
15	4-CH ₂ O(CH ₂) ₃ Cl	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ O(CH ₂) ₄ Cl	Cl	H	H	4-Cl
	4-CH ₂ O(CH ₂) ₅ Cl	Cl	H	H	4-Cl
20	4-CH ₂ O(CH ₂) ₅ Cl	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ O(CH ₂) ₆ Cl	Cl	H	H	4-Cl
25	4-CH ₂ O(CH ₂) ₇ Br	Cl	H	H	4-Cl
	4-CH ₂ O(CH ₂) ₇ Br	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ OCH ₂ CHClCH ₃	Cl	H	H	4-Cl
30	4-CH ₂ OCHCHCH ₃ H ₃ C Cl	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CHBrCH ₃	Cl	H	H	4-Cl
35	4-CH ₂ OC ₂ H ₄ CHClCH ₃	Cl	H	H	4-Cl
	4-CH ₂ OC ₂ H ₄ CHBrCH ₃	Cl	H	H	4-Cl
	4-CH ₂ OCHCH(Cl)CH ₂ Cl	Cl	H	H	4-Cl
40	4-CH ₂ OCH(CH ₃)C ₂ F ₅	Cl	H	H	4-Cl
	4-CH ₂ O(CH ₂) ₃ F	Cl	H	H	4-Cl
45	4-CH ₂ O(CH ₂) ₃ F	Cl	H	H	4-C ₂ H ₅
	4-CH ₂ O(CH ₂) ₄ F	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)}_m$	$\underline{R^4}$	$\underline{(R^5)}_n$
5	4-CH ₂ O(CH ₂) ₅ F	Cl	H	H	4-Cl
	4-CH ₂ O(CH ₂) ₆ F	Cl	H	H	4-Cl
	4-CH ₂ O(CH ₂) ₇ F	Cl	H	H	4-Cl
10	4-CH ₂ O(CH ₂) ₇ F	Cl	H	H	4-C ₂ H ₅
	4-CH(CH ₃)O(CH ₂) ₃ Br	Cl	H	H	4-Cl
	4-CH(CH ₃)O(CH ₂) ₃ Br	Cl	H	H	4-C ₂ H ₅
15	4-CH(CH ₃)O(CH ₂) ₃ Cl	Cl	H	H	4-Cl
	4-CH(CH ₃)O(CH ₂) ₄ Cl	Cl	H	H	4-Cl
20	4-CH(CH ₃)O(CH ₂) ₄ Br	Cl	H	H	4-Cl
	4-CH(CH ₃)O(CH ₂) ₅ Cl	Cl	H	H	4-Cl
	4-CH(CH ₃)O(CH ₂) ₆ Cl	Cl	H	H	4-Cl
25	4-CH(CH ₃)O(CH ₂) ₆ Br	Cl	H	H	4-Cl
	$ \begin{array}{c} 4-\text{CHOCH}_2\text{CHCH}_3 \\ \quad \\ \text{CH}_3 \quad \text{Cl} \end{array} $	Cl	H	H	4-Cl
30	$ \begin{array}{c} 4-\text{CH}-\text{O}-\text{CH}-\text{CHCH}_3 \\ \quad \quad \\ \text{CH}_3 \quad \text{CH}_3 \quad \text{Cl} \end{array} $	Cl	H	H	4-Cl
	$ \begin{array}{c} 4-\text{CHOCH}_2\text{CHCH}_3 \\ \quad \\ \text{CH}_3 \quad \text{Br} \end{array} $	Cl	H	H	4-Cl
35					
	$ \begin{array}{c} 4-\text{CHOC}_2\text{H}_4\text{CHCH}_3 \\ \quad \\ \text{CH}_3 \quad \text{Cl} \end{array} $	Cl	H	H	4-Cl
40					
	$ \begin{array}{c} 4-\text{CHOC}_2\text{H}_4\text{CHCH}_3 \\ \quad \\ \text{CH}_3 \quad \text{Cl} \end{array} $	Cl	H	H	4-C ₂ H ₅
45					
	$ \begin{array}{c} 4-\text{CHOC}_2\text{H}_4\text{CHCH}_3 \\ \quad \\ \text{CH}_3 \quad \text{Br} \end{array} $	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	4-CHOCH ₂ CHClCH ₂ Cl CH ₃	Cl	H	H	4-Cl
10	4-CHOCH ₂ CHClCH ₂ Cl CH ₃	Cl	H	H	4-C ₂ H ₅
15	4-CHOCH(CH ₃)C ₂ F ₅ CH ₃	Cl	H	H	4-Cl
20	4-CHOCH(CH ₃)C ₂ F ₅ CH ₃	Cl	H	H	4-C ₂ H ₅
25	4-CH(CH ₃)O(CH ₂) ₃ F	Cl	H	H	4-Cl
	4-CH(CH ₃)O(CH ₂) ₃ F	Cl	H	H	4-C ₂ H ₅
	4-CH(CH ₃)O(CH ₂) ₄ F	Cl	H	H	4-Cl
30	4-CH(CH ₃)O(CH ₂) ₅ F	Cl	H	H	4-Cl
	4-CH(CH ₃)O(CH ₂) ₆ F	Cl	H	H	4-Cl
	4-C ₂ H ₄ O(CH ₂) ₃ Br	Cl	H	H	4-Cl
35	4-C ₂ H ₄ O(CH ₂) ₃ Br	Cl	H	H	4-C ₂ H ₅
	4-C ₂ H ₄ O(CH ₂) ₃ Cl	Cl	H	H	4-Cl
	4-C ₂ H ₄ O(CH ₂) ₃ I	Cl	H	H	4-Cl
40	4-C ₂ H ₄ O(CH ₂) ₄ Cl	Cl	H	H	4-Cl
	4-C ₂ H ₄ O(CH ₂) ₄ Br	Cl	H	H	4-Cl
	4-C ₂ H ₄ O(CH ₂) ₄ Cl	Cl	H	H	4-C ₂ H ₅
	4-C ₂ H ₄ O(CH ₂) ₅ Cl	Cl	H	H	4-Cl
	4-C ₂ H ₄ O(CH ₂) ₅ Br	Cl	H	H	4-Cl
45	4-C ₂ H ₄ O(CH ₂) ₆ Cl	Cl	H	H	4-Cl
	4-C ₂ H ₄ O(CH ₂) ₆ Br	Cl	H	H	4-Cl

	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	$4-C_2H_4O(CH_2)_6Br$	Cl	H	H	$4-C_2H_5$
	$4-C_2H_4OCH_2CH(Cl)CH_3$	Cl	H	H	4-Cl
	$4-C_2H_4OCH-CHCH_3$ H ₃ C Cl	Cl	H	H	4-Cl
10	$4-C_2H_4OCH_2CHBrCH_3$	Cl	H	H	4-Cl
	$4-C_2H_4OC_2H_4CHCH_3$ Cl	Cl	H	H	4-Cl
15	$4-C_2H_4OC_2H_4CHCH_3$ Br	Cl	H	H	4-Cl
20	$4-C_2H_4OCH_2CHCH_2Cl$ Cl	Cl	H	H	4-Cl
25	$4-C_2H_4OCH(C_2F_5)CH_3$	Cl	H	H	4-Cl
	$4-C_2H_4O(CH_2)_3F$	Cl	H	H	4-Cl
	$4-C_2H_4O(CH_2)_3F$	Cl	H	H	$4-C_2H_5$
30	$4-C_2H_4O(CH_2)_4F$	Cl	H	H	4-Cl
	$4-C_2H_4O(CH_2)_5F$	Cl	H	H	4-Cl
	$4-C_2H_4O(CH_2)_6F$	Cl	H	H	4-Cl
35	$4-C_2H_4O(CH_2)_6F$	Cl	H	H	$4-C_2H_5$
	$4-CH_2C(Cl)=CH_2$	Cl	H	H	4-Cl
	$4-CH_2C(Cl)=CH_2$	Cl	H	H	$4-C_2H_5$
40	$4-CH_2C(Br)=CH_2$	Cl	H	H	4-Cl
	$4-CH_2CH=C(Cl)CH_3$	Cl	H	H	4-Cl
	$4-CH_2CH=C(Cl)CH_3$	Cl	H	H	$4-C_2H_5$
45	$4-(CH_2)_6C(Cl)=CH_2$	Cl	H	H	4-Cl

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	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)}_m$	$\underline{R^4}$	$\underline{(R^5)}_n$
5	4-CH ₂ CH=CHCl	Cl	H	H	4-Cl
	4-OCH ₂ C(Cl)=CHCl	Cl	H	H	4-Cl
	4-OCH ₂ C(Cl)=CHCl	Cl	H	H	4-C ₂ H ₅
10	4-OCH ₂ C(Cl)=CH ₂	Cl	H	H	4-Cl
	4-OCH ₂ C(Br)=CH ₂	Cl	H	H	4-Cl
	4-OCH ₂ CH(Cl)CH=CH ₂	Cl	H	H	4-Cl
15	4-OCH ₂ CH=C(Cl)CH ₃	Cl	H	H	4-Cl
	4-OCH ₂ CH=CHCl	Cl	H	H	4-Cl
20	4-O(CH ₂) ₆ C(Cl)=CH ₂	Cl	H	H	4-Cl
	4-OCH ₂ C(Cl)=CHCl	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CCl=CH ₂	Cl	H	H	4-Cl
25	4-CH ₂ OCH ₂ CBr=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH=C(CH ₃)Cl	Cl	H	H	4-Cl
30	4-CH ₂ OCH ₂ CH=C(CH ₃)Cl	Cl	H	H	4-C ₂ H ₅
35	4-CH ₂ O(CH ₂) ₅ C(CH ₃)=CH ₂	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ CH=CHCl	Cl	H	H	4-Cl
40	4-CH ₂ OCH=C(Cl)CH(Cl)Cl	Cl	H	H	4-Cl
	4-CH ₂ OCH ₂ C(CH ₃)=CHCl	Cl	H	H	4-Cl
45	4-CHOCH ₂ C(CH ₃)=CH ₂	Cl	H	H	4-Cl

	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	$4-\underset{\substack{ \\ \text{CH}_3}}{\text{CHOCH}_2}\underset{\substack{ \\ \text{Cl}}}{\text{C}}=\text{CH}_2$	Cl	H	H	$4-\text{C}_2\text{H}_5$
10	$4-\underset{\substack{ \\ \text{CH}_3}}{\text{CHOCH}_2}\underset{\substack{ \\ \text{Br}}}{\text{C}}=\text{CH}_2$	Cl	H	H	4-Cl
15	$4-\underset{\substack{ \\ \text{CH}_3}}{\text{CHOCH}_2}\text{CH}=\text{CHCl}$	Cl	H	H	4-Cl
20	$4-\underset{\substack{ \\ \text{CH}_3}}{\text{CHOCH}_2}\text{CH}=\text{CHCl}$	Cl	H	H	$4-\text{C}_2\text{H}_5$
25	$4-\underset{\substack{ \\ \text{CH}_3}}{\text{CHOCH}_2}\underset{\substack{ \\ \text{Cl}}}{\text{C}}=\text{CHCl}$	Cl	H	H	4-Cl
30	$4-\text{C}_2\text{H}_4\underset{\substack{ \\ \text{Cl}}}{\text{OCH}_2}\underset{\substack{ \\ \text{Cl}}}{\text{C}}=\text{CH}_2$	Cl	H	H	4-Cl
35	$4-\text{C}_2\text{H}_4\underset{\substack{ \\ \text{Cl}}}{\text{OCH}_2}\underset{\substack{ \\ \text{Cl}}}{\text{C}}=\text{CH}_2$	Cl	H	H	$4-\text{C}_2\text{H}_5$
40	$4-\text{C}_2\text{H}_4\underset{\substack{ \\ \text{Br}}}{\text{OCH}_2}\underset{\substack{ \\ \text{Br}}}{\text{C}}=\text{CH}_2$	Cl	H	H	4-Cl
45	$4-\text{C}_2\text{H}_4\underset{\substack{ \\ \text{Cl}}}{\text{OCH}_2}\text{CH}=\underset{\substack{ \\ \text{Cl}}}{\text{C}}\text{CH}_3$	Cl	H	H	4-Cl
50	$4-\text{C}_2\text{H}_4\text{OCH}_2\text{CH}=\text{CHCl}$	Cl	H	H	4-Cl
55	$4-\text{C}_2\text{H}_4\text{OCH}_2\text{CH}=\text{CHCl}$	Cl	H	H	$4-\text{C}_2\text{H}_5$
	$4-\text{C}_2\text{H}_4\text{OCH}_2\underset{\substack{ \\ \text{Cl}}}{\text{C}}=\text{CHCl}$	Cl	H	H	4-Cl
	$4-\text{OCH}_2\text{C}\equiv\text{CH}$	Cl	H	H	4-Cl
	$4-\text{OCH}_2\text{C}\equiv\text{CH}$	Cl	H	H	$4-\text{C}_2\text{H}_5$

	R^1	R^2	$(R^3)_m$	R^4	$(R^5)_n$
5	$4-OCH_2C\equiv CCH_3$	Cl	H	H	4-Cl
	$4-OCH_2C\equiv CC_2H_5$	Cl	H	H	4-Cl
	$4-OCH_2C\equiv CC_2H_5$	Cl	H	H	4- C_2H_5
10	$4-OCH_2C\equiv CC_3H_7$	Cl	H	H	4-Cl
	$4-OCH_2C\equiv CC_4H_9$	Cl	H	H	4-Cl
	$4-OCH_2C\equiv CC_5H_{11}$	Cl	H	H	4-Cl
15	$4-OCH_2C\equiv CC_5H_{11}$	Cl	H	H	4- C_2H_5
	$4-OCH(CH_3)C\equiv CH$	Cl	H	H	4-Cl
20	$4-OCH(C_2H_5)C\equiv CH$	Cl	H	H	4-Cl
	$4-OCH(C_2H_5)C\equiv CH$	Cl	H	H	4- C_2H_5
	$4-OCH(C_3H_7)C\equiv CH$	Cl	H	H	4-Cl
25	$4-OCH(C_2H_5)C\equiv CCH_3$	Cl	H	H	4-Cl
	$4-OCH(C_3H_7)C\equiv CCH_3$	Cl	H	H	4-Cl
	$4-OCH_2C\equiv C-iso-C_3H_7$	Cl	H	H	4-Cl
30	$4-OCH(CH_3)C\equiv C$ iso- C_3H_7	Cl	H	H	4-Cl
35	$4-OCHC\equiv CCH(CH_3)_2$ C_2H_5	Cl	H	H	4-Cl
	$4-OC_2H_4C\equiv CC_2H_5$	Cl	H	H	4-Cl
40	$4-OCH(C_3H_7)C\equiv CCH_3$	Cl	H	H	4-Cl
	$4-OCH(C_3H_7)C\equiv CCH_3$	Cl	H	H	4- C_2H_5
	5-O-sec- C_4H_9	Cl	H	H	4-Cl
45	5-O-sec- C_4H_9	Cl	H	H	4- C_2H_5
	5-O-sec- C_4H_9	Cl	4-Cl	H	4-Cl

50

55

	$\underline{R^1}$	$\underline{R^2}$	$\underline{(R^3)_m}$	$\underline{R^4}$	$\underline{(R^5)_n}$
5	5-O-sec-C ₄ H ₉	C1	4-C1	H	4-C ₂ H ₅
	5-O-sec-C ₄ H ₉	C1	4-F	H	4-C1
	5-O-sec-C ₄ H ₉	C1	4-F	H	4-C ₂ H ₅

10

Examples of the insect pests against which the aromatic compounds (I) of the invention exhibit controlling effects are as shown below.

15 Hemiptera:-

Planthoppers such as brown planthopper (Nilaparvata lugens), white-backed rice planthopper (Sogatella furcifera) and small brown planthopper (Laodelphax striatellus); leafhoppers such as green rice leafhopper (Nephotettix cincticeps), Nephotettix virescens, Nephotettix nigropictus, zig-zag rice leafhopper (Recilia dorsalis), tea green leafhopper (Empoasca onukii) and grape leafhopper (Arboridia apicalis); aphids such as cotton aphid (Aphis gossypii) and green peach aphid (Myzus persicae); bugs; whiteflies (Aleyrodidae) such as sweet potato whitefly (Bemisia tabaci) and greenhouse whitefly (Trialeurodes vaporariorum); scales; mealy bugs; lace bugs (Tingidae); psyllids (Psyllidae).

25 Lepidoptera:-

Pyralid moths (Pyralidae) such as rice stem borer (Chilo suppressalis), rice leafroller (Cnaphalocrocis medinalis) and Indian meal moth (Plodia interpunctella); Noctuidae such as tobacco curworm (Spodoptera litura), rice armyworm (Pseudaletia separata), cabbage armyworm (Mamestra brassicae) and beet semi-looper (Autographa nigrisigna); Agrothis spp. such as turnip cutworm (Agrothis segetum) and black cutworm (Agrothis ipsilon); Heliothis spp.; Pieridae such as common cabbageworm (Pieris rapae crucivora); tortricid moths (Tortricidae) such as Adoxophyes spp. and Grapholita spp.; Carposinidae such as Lyonetiid moths (Lyonetiidae), leafblotch miners (Gracillariidae), gelechiid moths (Gelechiidae) and tussock moths (Lymantriidae); diamondback moth (Plutella xylostella), clothes moths (Tineidae), casemaking clothes moth (Tinea translucens) and webbing clothes moth (Tineola bisselliella).

Diptera:-

Mosquitos (Calicidae) such as common mosquito (Culex pipiens pallens) and Culex tritaeniorhynchus; Aedes spp. such as Aedes aegypti and Aedes albopictus; Anopheles spp. such as Anopheles sinensis; midges (Chironomidae); Muscidae such as housefly (Musca domestica) and false stablefly (Muscina stabulans); Calliphoridae; Sarcophagidae; lesser housefly (Fannia canicularis); anthomyiid flies (Anthomyiidae) such as seedcorn maggot (Delia platura) and onion maggot (Delia antiqua); fruit flies (Tephritidae); shore flies (Ephydriidae); small fruit flies (Drosophilidae); moth flies (Psychodidae); black flies (Simuliidae); Tabanidae; stable flies (Stomoxys).

Coleoptera:-

Leaf beetles (Chrysomelidae) such as cucurbit beetle (Aulacophora femoralis), striped flea beetles (Phyllotreta striolata), western corn rootworm (Diabrotica virgifera) and southern corn root worm (Diabrotica undecimpunctata); scarabs (Scarabaeidae) such as cupreous chafer (Anomala cuprea) and soybean beetle (Anomala rufocuprea); weevils (Cureulionidae) such as maize weevil (Sitophilus zeamais), rice water weevil (Lissorhoptrus oryzophilus) and adzuki bean weevil (Callosobruchys chinensis), etc.; darkling beetles (Tenebrionidae) such as yellow mealworm (Tenebrio molitor) and red flour beetles (Tribolium castaneum); Anobiidae; Coccinellidae such as twenty-eight-spotted ladybirds (Epilachna vigintioctopunctata); powderpost beetles (Lyctidae); false powderpost beetles (Bostrychidae); Cerambycidae.

Dictyoptera:-

Blattellidae such as German cockroach (Blattella germanica); Blattidae such as smokybrown cockroach (Periplaneta fuliginosa), American cockroach (Periplaneta americana), brown cockroach (Periplaneta brunnea) and oriental cockroach (Blatta orientalis).

5 Thysanoptera:-

Thrips such as Thrips palmi, yellow tea thrips (Scirtothrips dorsalis) and flower thrips (Thrips hawaiiensis).

10 Hymenoptera:-

Ants (Formicidae); sawflies (Tenthredinidae) such as cabbage sawfly (Athalia rosae ruficornis).

Orthoptera:-

15

Mole crickets (Gryllotalpidae); grasshoppers (Acrididae).

Aphaniptera:-

20 Purex irritans.

Anoplura:-

Pediculus humanus capitis, Phthirus pubis

25

Isoptera:-

Reticulitermes speratus, Formosan subterranean termite (Coptotermes formosanus).

30 Among the insect pests as above exemplified, the aromatic compounds (I) are particularly effective in controlling those belonging to Hemiptera and also exhibit a remarkable controlling effect on planthoppers and leaf-hoppers in a field of rice plant or aphids.

The aromatic compounds (I) may be used alone as insecticides or in mixtures with other insecticides and/or acaricides to enhance or expand their insecticidal or pesticidal use.

Examples of the other insecticides and/or acaricide include organophosphorus compounds (e.g. fenitrothion (O,O-dimethyl O-(3-methyl-4-nitrophenyl)phosphorothioate), fenthion (O,O-dimethyl O-[3-methyl-4-(methylthio)phenyl]phosphorothioate), diazinon (O,O-diethyl-O-(2-isopropyl-6-methyl-pyrimidin-4-yl)-phosphorothioate), chlorpyrifos (O,O-diethyl-O-(3,5,6-trichloro-2-pyridyl)phosphorothioate), acephate (O,S-dimethyl acetylphosphoramidodithioate), methidathion (S-2,3-dihydro-5-methoxy-2-oxo-1,3,4-thiadiazol-3-ylmethyl O,O-dimethylphosphorodithioate), disulfoton (O,O-diethyl S-2-ethylthioethyl phosphorothioate), DDVP (2,2-dichlorovinyl dimethylphosphate), sulprofos (O-ethyl O-4-(methylthio)phenyl S-propyl phosphorodithioate), cyanophos (O-4-cyanophenyl O,O-dimethyl phosphorothioate), dioxabenzofos (2-methoxy-4H-1,3,2-benzodioxaphosphinine-2-sulphide), dimethoate (O,O-diethyl-S-(N-methylcarbamoylmethyl)dithiophosphate), phenthoate (ethyl 2-dimethoxyphosphinothioylthio(phenyl)acetate), malathion (diethyl (dimethoxyphosphinothioylthio)succinate), trichlorfon (dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate), azinphos-methyl (S-3,4-dihydro-4-oxo-1,2,3-benzotriazin-3-ylmethyl O,O-dimethylphosphorodithioate) and monocrotophos (dimethyl (E)-1-methyl-2-(methylcarbamoyl)vinyl phosphate)); carbamate derivatives (e.g. BPMC (2-sec-butylphenyl methylcarbamate), benfuracarb (ethyl N-[2,3-dihydro-2,2-dimethylbenzofuran-7-yloxycarbonyl-(methyl)aminothio]-N-isopropyl-beta-alaninate), propoxur (2-isopropoxyphenyl N-methylcarbamate), carbosulfan (2,3-dihydro-2,2-dimethyl-7-benzo[b]furanyl N-methylcarbamate), carbaryl (1-naphthyl-N-methylcarbamate), methomyl (S-methyl-N-[(methylcarbamoyl)oxy]thioacetimidate), ethiofencarb (2-(ethylthiomethyl)phenyl methylcarbamate), aldicarb (2-methyl-2-(methylthio)propionaldehyde O-methylcarbamoyloxime) and Oxamyl (N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide)); pyrethroides (e.g. ethofenprop (2-(4-ethoxyphenyl-2-methylpropyl-3-phenoxybenzylether), fenvalerate ((RS)-alpha-cyano-3-phenoxybenzyl (RS)-2-(4-chlorophenyl)-3-methylbutyrate), esfenvalerate ((S)-alpha-cyano-3-phenoxybenzyl (S)-2-(4-chlorophenyl)-3-methylbutyrate), fenpropathrin ((RS)-alpha-cyano-3-phenoxybenzyl 2,2,3,3-tetramethylcyclopropanecarboxylate), cypermethrin ((RS)-alpha-cyano-3-phenoxybenzyl (1RS,3RS)-(1RS,3RS)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate), permethrin (3-phenoxybenzyl (1RS,3RS)-(1RS,3RS)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate), cyhaloth-

rin ((R,S)-alpha-cyano-3-phenoxybenzyl (Z)-(1R,3R)-3-(2-chloro-3,3,3-trifluoropropenyl)-2,2-dimethylcyclopropanecarboxylate), deltamethrin ((S)-alpha-cyano-m-phenoxybenzyl (1R,3R)-3-(2,2-dibromovinyl)-2-dimethylcyclopropanecarboxylate) and cycloprothrin ((RS)-alpha-cyano-3-phenoxybenzyl (RS)-2,2-dichloro-1-(4-ethoxyphenyl)cyclopropanecarboxylate)); thiadiazine derivatives (e.g. buprofezin (2-tert-butylimino-3-isopropyl-5-phenyl-1,3,5-triazin-4-one)); nitroimidazolidine derivatives (e.g. imidacloprid (1-(6-chloro-3-pyridylmethyl)-N-nitro-imidazolidin-2-ylideneamine)); nereistoxin derivatives (e.g. cartap (S,S'-(2-dimethylaminotrimethylene) bis(thiocarbamate), thiocyclam (N,N-dimethyl-1,2,3-trithian-5-ylamine) and ben-sultap (S,S'-2-dimethylaminotrimethylene di(benzenethiosulphonate)); halogenated hydrocarbons (e.g. endosulfan (6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide) and gamma-BHC (1,2,3,4,5,6-hexachlorocyclohexane)); benzoylphenylurea derivatives (e.g. chlorfluazuron (1-[3,5-dichloro-4-(3-chloro-5-trifluoromethylpyridin-2-yloxy)phenyl]-3-(2,6-difluorobenzoyl)urea), teflubenzuron (1-(3,5-dichloro-2,4-difluorophenyl)-3-(2,6-difluorobenzoyl)urea) and flufenoxuron (1-[4-(2-chloro-4-trifluoromethylphenoxy)-2-fluorophenyl]-3-(2,6-difluorobenzoyl)urea); formamidine derivatives (e.g. amitraz (N,N'-[(methylimino)dimethylidene]-di-2,4-xylidine) and chlordimeform (N'-(4-chloro-2-methylphenyl)-N,N-dimethylmethanimidamide)).

On the practical use of the aromatic compounds (I) as insecticides, they may be employed as such but are normally mixed with appropriate additives such as solid carriers, liquid carriers, gaseous carriers and feed to formulate their compositions. When desired or necessary, surfactants and other adjuvants may be further incorporated therein. The compositions may be prepared into any conventional forms such as oil sprays, emulsifiable concentrates, wettable powders, flowable concentrates (e.g. water-based suspension formulations, water-based emulsion formulations), granules, dusts, aerosols, heating smoking formulations (e.g. self-burning-type smoking formulations, chemical reaction-type smoking formulations, porous ceramic plate-type smoking formulations), ULV formulations and poison baits.

The composition of the invention contains generally the aromatic compound(s) (I) as the active ingredient in an amount of from about 0.001 % to 95 % by weight based on the composition.

Examples of the solid carrier usable for making the composition are fine powders or granules of clays (e.g. kaolin clay, diatomaceous earth, synthetic hydrated silica, bentonite, Fubasami clay, terra alba), talc, ceramics, other inorganic minerals (e.g. sericite, quartz, sulfur, activated carbon, calcium carbonate, hydrated silica) and chemical fertilizers (e.g. ammonium sulfate, ammonium phosphate, ammonium nitrate, urea, ammonium chloride). Examples of the liquid carrier include water, alcohols (e.g. methanol, ethanol), ketones (e.g. acetone, methyl ethyl ketone), aromatic hydrocarbons (e.g. benzene, toluene, xylene, ethylbenzene, methylnaphthalene), aliphatic hydrocarbons (e.g. hexane, cyclohexane, kerosene, gas oil), esters (e.g. ethyl acetate, butyl acetate), nitriles (e.g. acetonitriles, isobutyronitrile), ethers (e.g. diisopropyl ether, dioxane), acid amides (e.g. N,N-dimethylformamide, N,N-dimethylacetamide), halogenated hydrocarbons (e.g. dichloromethane, trichloroethane, carbon tetrachloride), dimethylsulfoxide and vegetable oils (e.g. soybean oil, cotton seed oil). Examples of the gaseous carrier, i.e. a propellant, include freon gas, butane gas, LPG (liquefied petroleum gas), dimethyl ether and carbon dioxide.

Examples of the surfactant are alkylsulfates, alkylsulfonates, alkylarylsulfonates, alkyl aryl ethers and polyoxyethylene derivatives thereof, polyethylene glycol ethers, polyvalent alcohol esters and sugar alcohol derivatives. Examples of the adjuvants such as binders and dispersing agents are casein, gelatin, polysaccharides (e.g. starch powders, gum arabic, cellulose derivatives, alginic acid), lignin derivatives, bentonite, sugars and synthetic water-soluble high molecular weight substances (e.g. polyacrylic alcohol, polyvinylpyrrolidone, polyacrylic acid).

Examples of the stabilizer include PAP (acidic isopropyl phosphate), BHT (2,6-di-tert-butyl-4-methylphenol), BHA (mixture of 2-tert-butyl-4-methoxyphenol and 3-tert-butyl-4-methoxyphenol), vegetable oils, mineral oils, surfactants and fatty acids or esters thereof.

The base material for self-burning-type smoking formulations may include, for example, burning heat-generating agents such as nitrates, nitrites, guanidine salts, potassium chlorate, nitrocellulose, ethyl cellulose and wood powders, pyrolysis-promoting agents such as alkali metal salts, alkaline earth metal salts, dichromates and chromates, oxygen-supplying agents such as potassium nitrate, burning-supporting agents such as melamine and wheat starch, extenders such as diatomaceous earth and binders such as synthetic pastes. The base material for chemical reaction-type smoking formulations can include, for example, heat-generating agents such as alkali metal sulfides, alkali metal polysulfides, alkali metal hydrosulfides, hydrated salts of alkali metals and calcium oxide, catalyzing agents such as carbonaceous substances, iron carbide and activated clay, organic foaming agents such as azodicarbonamide, benzenesulfonyl hydrazides, dinitrosopentamethylenetetramine, polystyrene and polyurethane, fillers such as natural fiber pieces and synthetic fiber pieces. The base material for poison baits may contain feed components such as crop powders, essential vegetable oil, sugars and crystalline cellulose, antioxidants

such as dibutylhydroxytoluene and nordihydroguaiaretic acid, preservatives such as dehydroacetic acid, feeding error preventing agents such as red paper powders, incentive flavors such as cheese flavor and onion flavor.

Flowable concentrates (water-based suspension or emulsion formulations) are generally obtained by dispersing about 1 to 75 parts by weight of the aromatic compound (I) as the active ingredient finely and uniformly into water containing about 0.5 to 15 parts by weight of a dispersing agent, about 0.1 to 10 parts by weight of a suspending agent (e.g. protective colloids, compounds giving a thixotropic property) and optionally about 0 to 10 parts by weight of an auxiliary agent(s) such as a defoaming agent, an anticorrosive agent, a stabilizing agent, a spreading agent, penetration auxiliaries, antifreezing agent, an antibacterial agent and an antimolding agent. The use of an oil, into which the active ingredient is hardly soluble, in place of water affords oil-based suspension formulations. Examples of the protective colloids as above mentioned are gelatin, casein, gums, cellulose ethers and polyvinyl alcohol.

Examples of the compounds giving a thixotropic property are bentonite, aluminum magnesium silicate, xanthane gum and polyacrylic acid.

The composition of the invention thus obtained may be used as such or after diluting with water. It may be also used in a mixture with any other active component or composition chosen from insecticides, nematocides, acaricides, fungicides, bacteriocides, herbicides, plant growth regulators, synergistic agents, fertilizers, soil conditioners and animal feed. Alternatively, the composition of the invention may be applied separately but simultaneously with said other active component or composition.

For the purpose of controlling insect pests in the agricultural field, the aromatic compound (I) according to the present invention may be applied to the insect pests or the locus where the insect pests propagate generally in an amount of about 0.001 g to 500 g, and preferably about 0.1 g to 500 g per 10 ares. When the aromatic compound (I) is applied in a form of emulsifiable concentrate, wettable powder or flowable concentrate after dilution with water, its concentration may be from about 0.0001 to 1000 ppm. Granules and dusts may be used as such, i.e. without water dilution. When the aromatic compound (I) is used for household or public hygiene, it may be used in the form of an emulsifiable concentrate, wettable powder, flowable concentrate or in a similar form with water dilution. In this case, the concentration of the active ingredient may be from about 0.0001 to 10,000 ppm. In case of oils, aerosol, fumigants, ULV formulations and poison baits, they may be applied as such. However, the doses and concentrations may vary within broad ranges depending upon the composition, the application time, the place applied, the application method, the kind of insect pests and the condition of damage, and may be increased or decreased, irrespective of the general ranges set forth above.

Practical and presently preferred embodiments of the invention will be hereinafter explained in more detail referring to Production Examples, Formulation Examples and Test Examples. These examples, however, should not be construed to be limitative.

In the following Production Examples, % is by weight unless otherwise indicated.

Production Example 1 (Production of Compound No. 1)

A mixture of 0.30 g of potassium carbonate, 0.40 g of 2-chloro-4-sec-butoxyphenol, 0.32 g of p-chlorobenzyl chloride and 15 ml of N,N-dimethylformamide was stirred at room temperature overnight. The reaction mixture was poured into ice-water and extracted twice with 100 ml of ethyl acetate. The extracts were combined together, washed with water, dried over anhydrous magnesium sulfate and concentrated under reduced pressure. The residue was subjected to silica gel chromatography to give 0.51 g of 1-sec-butoxy-3-chloro-4-(4-chlorobenzoyloxy)benzene. Yield, 78 %.

$$n_D^{20.6}$$

1.5630.

Production Example 2 (Production of Compound No. 27)

A mixture of 0.30 g of potassium carbonate, 0.40 g of 2-chloro-4-sec-butoxyphenol, 0.28 g of p-methylbenzyl chloride and 15 ml of N,N-dimethylformamide was stirred at room temperature overnight. The reaction mixture was poured into ice-water and extracted twice with 100 ml of ethyl acetate. The extracts were combined together, washed with water, dried over anhydrous magnesium sulfate and concentrated

under reduced pressure. The residue was subjected to silica gel chromatography to give 0.50 g of 1-sec-butoxy-3-chloro-4-(4-methylbenzyloxy)benzene. Yield, 82 %.

$$n_D^{18.9}$$

1.5557.

10 Production Example 3 (Production of Compound No. 36)

A mixture of 0.30 g of potassium carbonate, 0.40 g of 2-chloro-4-sec-butoxyphenol, 0.37 g of p-fluorobenzyl bromide and 15 ml of N,N-dimethylformamide is stirred at room temperature overnight. The reaction mixture is poured into ice-water and extracted twice with 100 ml of ethyl acetate. The extracts are
15 combined together, washed with water, dried over anhydrous magnesium sulfate and concentrated under reduced pressure. The residue is subjected to silica gel chromatography to give 1-sec-butoxy-3-chloro-4-(4-fluorobenzyloxy)benzene.

Production Example 4 (Production of Compound No. 2)

20 A mixture of 0.75 g of 2-chloro-4-(2-ethylbutyl)phenol, 0.50 g of p-chlorobenzyl alcohol, 0.92 g of triphenylphosphine, 0.71 g of diisopropylazadicarboxylate and 100 mg of tetrahydrofuran was stirred at room temperature for 48 hours. The reaction mixture was concentrated, and 50 ml of diethyl ether was added thereto. The precipitates were removed by filtration, and the filtrate was concentrated. The residue was
25 subjected to silica gel chromatography to give 0.75 g of 2-chloro-1-(4-chlorobenzyloxy)-4-(2-ethylbutyl)-benzene. Yield, 63 %.

$$n_D^{22.6}$$

1.5611.

Production Example 5 (Production of Compound No. 26)

35 A mixture of 0.74 g of 2-chloro-4-sec-butoxyphenol, 0.50 g of p-ethylbenzyl alcohol, 1.00 g of triphenylphosphine, 0.65 g of diethylazadicarboxylate and 100 mg of tetrahydrofuran was stirred at room temperature for 48 hours. The reaction mixture was concentrated, and 50 ml of diethyl ether was added thereto. The precipitates were removed by filtration, and the filtrate was concentrated. The residue was
40 subjected to silica gel chromatography to give 0.71 g of 1-sec-butoxy-3-chloro-4-(4-ethylbenzyloxy)benzene. Yield, 60 %.

$$n_D^{22.6}$$

1.5529.

Some examples of the aromatic compounds (I) as produced in the same manner as above are shown in Table 2.

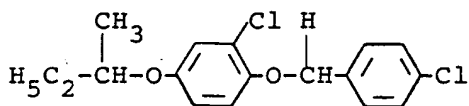
Table 2

Com-
pound
No.

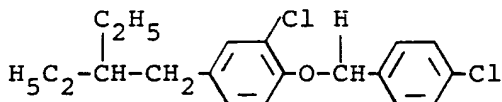
Chemical structure

Physical
constant

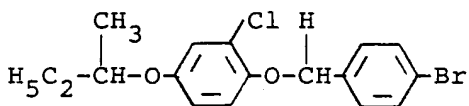
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 $n_{\text{D}}^{20.6} \quad 1.5630$

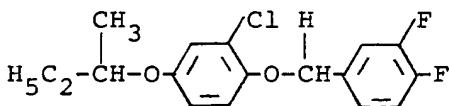
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 $n_{\text{D}}^{22.6} \quad 1.5611$

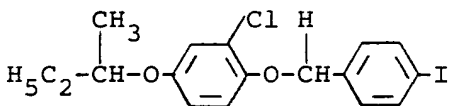
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 $n_{\text{D}}^{24.1} \quad 1.5730$

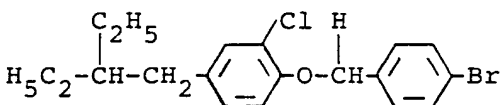
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 $n_{\text{D}}^{18.5} \quad 1.5372$

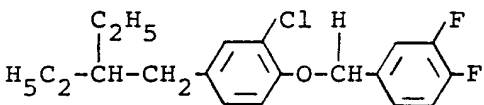
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 $n_{\text{D}}^{18.7} \quad 1.6013$

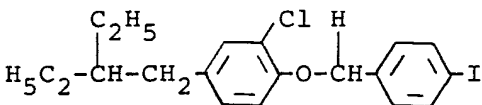
6


 $n_{\text{D}}^{23.4} \quad 1.5723$

7


 $n_{\text{D}}^{24.0} \quad 1.5724$

8


 $n_{\text{D}}^{23.5} \quad 1.5996$

Compound No.	Chemical structure	Physical constant
9		$n_D^{24.6}$ 1.5558
10		$n_D^{24.5}$ 1.5479
11		$n_D^{22.7}$ 1.5462
12		$n_D^{22.7}$ 1.5570
13		$n_D^{23.0}$ 1.5730
14		$n_D^{23.0}$ 1.5660
15		$n_D^{24.4}$ 1.5630
16		$n_D^{23.1}$ 1.5600

Compound No.	Chemical structure	Physical constant
17		$n_D^{23.2}$ 1.5555
18		$n_D^{24.4}$ 1.5599
19		$n_D^{23.8}$ 1.5661
20		$n_D^{24.4}$ 1.5592
21		$n_D^{24.7}$ 1.5542
22		$n_D^{24.4}$ 1.5587
23		$n_D^{22.0}$ 1.5558
24		$n_D^{21.8}$ 1.5565

Compound No.	Chemical structure	Physical constant
25		$n_D^{24.4}$ 1.5582
26		$n_D^{20.6}$ 1.5529
27		$n_D^{18.9}$ 1.5557
28		$n_D^{18.4}$ 1.5191
29		$n_D^{24.6}$ 1.5497
30		$n_D^{23.9}$ 1.5479
31		$n_D^{23.4}$ 1.5156
32		$n_D^{24.8}$ 1.5449

Compound No.	Chemical structure	Physical constant
33		$n_D^{24.8}$ 1.5432
34		$n_D^{24.5}$ 1.5672
35		$n_D^{24.5}$ 1.5509
36		

A typical embodiment for production of the intermediary compound (II) is shown below.

Production Example 6 (Production of the compound (IV), i.e. 4-sec-butoxy-2-chlorophenol)

To a solution of 5.0 g of 4-sec-butoxyphenol in 50 ml of carbon tetrachloride, there was added dropwise 3.27 g of t-butylhypochlorite with vigorously stirring and ice-cooling. After completion of the addition, the reaction mixture was stirred at room temperature for 5 hours and concentrated, followed by addition of 200 ml of ethyl acetate. The obtained solution was washed with an aqueous solution of 5 % wt. sodium dicarbonate, dried and concentrated under reduced pressure. The residue was subjected to silica gel chromatography to give 5.32 g of 4-sec-butoxy-2-chlorophenol. Yield. 88 %.

$$n_D^{23.5}$$

1.5312.

Some examples of the intermediary compound (II) as produced in the same manner as above are shown in Table 3.

Table 3

Compound No.	Chemical structure	Physical constant
101		$n_D^{23.5}$ 1.5312
102		$n_D^{22.0}$ 1.5266
103		$n_D^{22.0}$ 1.5240

In Formulation Examples as set forth below, parts and % are all by weight. The compound numbers correspond to those as shown in Table 2.

Formulation Example 1 (Emulsifiable concentrate)

To a solution of 10 parts of each of Compounds Nos. 1 to 36 in 35 parts of xylene and 35 parts of dimethylformamide, 14 parts of polyoxyethylene styrylphenyl ether and 6 parts of calcium dodecylbenzenesulfonate are added, and the resultant mixture is thoroughly mixed while stirring to give an emulsifiable concentrate containing the active ingredient in 10 %.

Formulation Example 2 (Wettable powder)

Twenty parts of each of Compounds Nos. 1 to 36 are added to a mixture of 4 parts of sodium laurylsulfate, 2 parts of calcium ligninsulfonate, 20 parts of fine powders of synthetic hydrated silica and 54 parts of diatomaceous earth, and the resultant mixture is stirred in a mixer to give a wettable powder containing the active ingredient in 20 %.

Formulation Example 3 (Granules)

Five parts of sodium dodecylbenzenesulfonate, 30 parts of bentonite and 60 parts of clay are added to 5 parts of each of Compound Nos. 1 to 36, and the resultant mixture is pulverized and kneaded with a suitable amount of water. The mixture is granulated in a granulator and air-dried to give granules containing the active ingredient in 5 %.

Formulation Example 4 (Dusts)

To a mixture of 1 part of fine powders of synthetic hydrated silica, 1 part of an aggregating agent ("Driless B" manufactured by Sankyo Co., Ltd.) and 7.7 parts of clay, 0.3 part of each of Compound Nos. 1 to 36 is added, and the resultant mixture is well pestled in a mortar and further stirred in a mixer. To the thus obtained mixture, there are added 90 parts of cut clay, followed by mixing to give dusts containing the active ingredient in 0.3 %.

Formulation Example 5 (Dusts)

A mixture of 0.3 part of each of Compound Nos. 1 to 36, 2 parts of fenitrothion (O,O-dimethyl O-(3-methyl-4-nitrophenyl)phosphorothioate as an organophosphorus insecticide, 3 parts of fine powders of

synthetic hydrated silica, 1 part of "Driless B" and 3.7 parts of clay are pestled in a mortar and stirred in a mixer. Then, 90 parts of cut clay are added thereto, and the resultant mixture is further mixed in a sack to give dusts.

5 Formulation Example 6 (Dusts)

A mixture of 0.3 part of each of Compound Nos. 1 to 36, 2 parts of BPMC (O-sec-butylphenyl N-methylcarbamate) as a carbamate insecticide, 3 parts of fine powders of synthetic hydrated silica, 1 part of "Driless B" and 3.7 parts of clay are pestled in a mortar and stirred in a mixer. Then, 90 parts of cut clay
10 are added thereto, and the resultant mixture is further mixed in a sack to give dusts.

Formulation Example 7 (Dusts)

To a solution of 1 part of each of Compound Nos. 1 to 36 in an appropriate amount of acetone, 5 parts
15 of fine powders of synthetic hydrated silica, 0.3 part of PAP (acidic isopropyl phosphate) and 93.7 parts of clay are added, and the resultant mixture is stirred in a mixer, followed by evaporation of acetone to give dusts containing the active ingredient in 1 %.

Formulation Example 8 (Flowable concentrate)

To 40 parts of an aqueous solution containing 2 parts of polyvinyl alcohol, 10 parts of each of Compound Nos. 1 to 36 are added, and the resultant mixture is stirred in a mixer. To the thus obtained dispersion, 40 parts of an aqueous solution containing 0.05 part of xanthane gum and 0.1 part of aluminum magnesium silicate are added, followed by addition of 10 parts of propylene glycol. The mixture is gently
20 stirred to give a flowable concentrate containing the active ingredient in 10 %.

Formulation Example 9 (Oil spray)

Into a mixture of 5 parts of xylene and 5 parts of trichloroethane, 0.1 part of each of Compound Nos. 1
30 to 36 is dissolved, and the resultant solution is mixed with 89.9 parts of deodorized kerosene to give an oil spray containing the active ingredient in 0.1 %.

Formulation Example 10 (Oil-based aerosol)

A solution of 0.1 part of each of Compound Nos. 1 to 36, 0.2 part of tetramethrin (2,2-dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylic acid (1,2,3,4,5,7-hexahydro-1,3-dioxo-2H-indol-2-yl)methyl ester) and 0.1 part of d-phenothrin (2,2-dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylic acid (3-phenoxyphenyl)methyl ester) in a mixture of 10 parts of trichloroethane and 59.6 parts of deodorized kerosene is filled in an aerosol container. After provision of a valve, 30 parts of a propellant (liquefied petroleum gas) is filled through the valve under compression to give an oil-based aerosol.
40

Formulation Example 11 (Water-based aerosol)

A solution of 0.2 part of each of Compound Nos. 1 to 36, 0.2 part of d-allethrin ((2,2-dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylic acid 2-methyl-4-oxo-3-(2-propenyl)-2-cyclopenten-2-yl ester), 0.2
45 part of d-phenothrin, 5 parts of xylene, 3.4 parts of deodorized kerosene and 1 part of an emulsifier ("ATMOS 300"®, Atlas Chemical Co., Ltd.) in 50 parts of distilled water is filled in an aerosol container. After provision of a valve, 40 parts of a propellant (liquefied petroleum gas) is filled through the valve under compression to give a water-based aerosol.

50 Formulation Example 12 (Fumigant)

Each of Compound Nos. 1 to 36 (100 mg) is dissolved in an appropriate amount of acetone, and the resultant solution is impregnated with a porous ceramic plate (4.0 x 4.0 x 1.2 cm) to give a fumigant.

55 The following Test Examples show some of test results which support the controlling effect of the aromatic compounds (I) on insect pests. The compound numbers correspond to those as shown in Table 2. The compounds used for comparison are as follows:

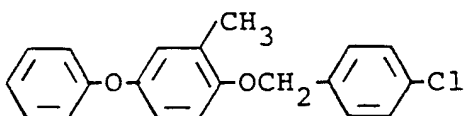
Compound
symbol

Chemical structure

Remarks

5

A

Compound disclosed
in U.S. patent
3,987,102

10

Test Example 1

Metamorphosis inhibitory activity against brown rice planthopper nymphs:-

15

An emulfiable concentrate prepared according to Formulation Example 1 was diluted with water to make a predetermined concentration. The dilution was sprayed onto rice plants cultivated in polyethylene cups at a rate of 20 ml/2 pots on a turning table. After air-drying, the plants were infested with about ten 3rd instar nymphs of brown rice planthopper (*Nilaparvata lugens*). After 10 days, the number of normal adults was counted to obtain an emergence inhibitory rate. The results are shown in Table 4.

20

Table 4

25

Compound
No.

Concentration (ppm)

Inhibitory
rate (%)

30

1

50

100

5

100

2

50

100

5

100

3

50

100

5

100

4

50

100

5

100

35

5

50

100

5

100

6

50

100

5

100

7

50

100

5

100

40

8

50

100

5

100

9

50

100

5

100

45

10

50

100

5

100

11

50

100

5

100

12

50

100

50

5

100

55

			(Continued)
	Compound No.	Concentration (ppm)	Inhibitory rate (%)
5	13	50	100
		5	100
	14	50	100
		5	100
10	15	50	100
		5	100
	16	50	100
		5	100
	17	50	100
15		5	100
	18	50	100
		5	100
	19	50	100
		5	100
20	20	50	100
		5	100
	21	50	100
		5	100
	22	50	100
25		5	100
	23	50	100
		5	100
	24	50	100
		5	100
30	25	50	100
		5	100
	26	50	100
		5	100
	27	50	100
		5	100
35	28	50	100
		5	100
	29	50	100
		5	100
	30	50	100
40		5	100
	31	50	100
		5	100
	32	50	100
		5	100
45	33	50	100
		5	100
	34	50	100
		5	100
	35	50	100
50		5	100
	A	50	25

Compound Nos. 1, 2, 3, 5, 6, 8, 9, 12, 13, 19 and 26 to 33 showed a 100 % emergence inhibition at a
 55 concentration of 500 ppb.

Test Example 2

Reproduction inhibitory activity against green rice leafhopper:-

An emulifiable concentrate prepared according to Formulation Example 1 was diluted with water to make a predetermined concentration. The dilution was sprayed onto rice plants (about 20 cm in height) cultivated in plastic pots (1/5000 are in width) at a rate of 40 ml/2 pots on a turning table. After air-drying, the pots were covered with wire cages, and each 10 male and female adults of green rice leafhopper (*Nephotettix cincticeps*) were released in each of the cages. After 3 weeks, the number of nymphs was counted to obtain a reproduction inhibitory rate. The results are shown in Table 5.

Table 5

Compound No.	Concentration (ppm)	Inhibitory rate (%)
1	100	100
26	100	98
27	100	99
A	100	0

Test Example 3

Reproduction inhibitory activity against brown rice planthopper:-

An emulifiable concentrate prepared according to Formulation Example 1 was diluted with water to make a predetermined concentration. The dilution was sprayed onto rice plants (about 20 cm in height) cultivated in plastic pots (1/5000 are in width) at a rate of 40 ml/2 pots on a turning table. After air-drying, the pots were covered with wire cages, and each 5 male and female adults of brown rice planthopper (*Nilaparvata lugens*) were released in each of the cages. After about 3 weeks, the number of nymphs was counted to obtain a reproduction inhibitory rate. The results are shown in Table 6.

Table 6

Compound No.	Concentration (ppm)	Ovicidal rate (%)
1	100	100
26	100	95
27	100	97
A	100	0

Test Example 4

Reproduction inhibitory activity against cotton aphids:-

An emulifiable concentrate prepared according to Formulation Example 1 was diluted with water to make a predetermined concentration. The dilution was sprayed onto potted cotton plants (in a stage of 8-9 days after sowing) infested with 1st instar nymphs of cotton aphids (*Aphis gossypii*) at a rate of 30 ml/2 pots on a turning table. Before spraying and one week after spraying, the number of nymphs and adults was counted, and a reproduction inhibitory index was expressed by the following equation:

$$\text{Reproduction inhibitory index} = \frac{\text{Number of individuals one week after spraying per 2 pots}}{\text{Number of individuals before spraying per 2 pots}}$$

wherein the judgement of activity is based on the following standard:

- A: less than 1 (excellent effect)
 B: from 1 to 3 (slight effect)
 C: more than 3 (little effect)
 D: same as in the untreated pots (no effect)

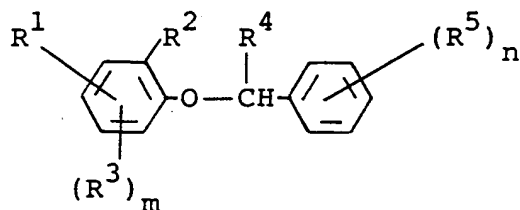
The results are shown in Table 7.

Table 7

Compound No.	Concentration (ppm)	Inhibitory rate
26	10	A
27	10	A
29	10	A
A	10	D

Claims

1. An aromatic compound of the formula:

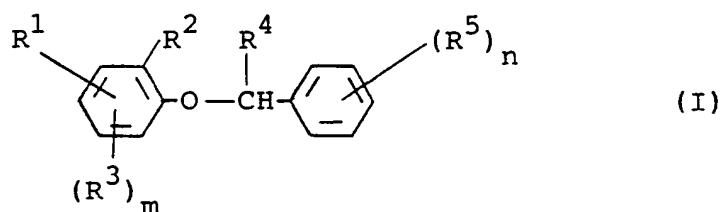


wherein R¹ is a C₃-C₈ alkyl group, a C₃-C₈ alkoxy group, an alkoxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ alkenyl group, a C₃-C₈ alkenyloxy group, an alkenyloxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ haloalkyl group, a C₃-C₈ haloalkoxy group, a haloalkoxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ haloalkenyl group, a C₃-C₈ haloalkenyloxy group, a haloalkenyloxyalkyl group having 3 to 8 carbon atoms or a C₃-C₈ alkynyloxy group; R² is a halogen atom; R³ is, the same or different, a hydrogen atom, a halogen atom or a methyl group; R⁴ is a hydrogen atom or a methyl group; R⁵ is, the same or different, a hydrogen atom, a halogen atom, a C₁-C₄ alkyl group, a C₁-C₄ haloalkyl group, a C₁-C₄ alkoxy group, a C₁-C₄ haloalkoxy group, a C₁-C₄ alkylthio group, a C₁-C₄ haloalkylthio group, a 3,4-methylenedioxy group, a methoxymethyl group, a cyano group or a nitro group; m is an integer of 1 to 3; and n is an integer of 1 to 5.

2. The aromatic compound according to claim 1, wherein R² is a chlorine atom.
3. The aromatic compound according to claim 1, wherein R² is a chlorine atom and R⁵ is, the same or different, a halogen atom.
4. The aromatic compound according to claim 1, wherein R² is a chlorine atom and R⁵ is an ethyl group.
5. The aromatic compound according to claim 1, which is
 1-sec-butoxy-3-chloro-4-(4-chlorobenzoyloxy)benzene,
 1-sec-butoxy-4-(4-bromobenzoyloxy)-3-chlorobenzene,
 1-sec-butoxy-3-chloro-4-(4-iodobenzoyloxy)benzene,
 1-sec-butoxy-3-chloro-4-(4-ethylbenzoyloxy)benzene,

1-sec-butoxy-3-chloro-4-(4-methylbenzyloxy)benzene,
 1-sec-butoxy-3-chloro-4-(4-trifluoromethylbenzyloxy)benzene,
 3-chloro-4-(4-chlorobenzyloxy)-1-isobutoxymethylbenzene,
 3-chloro-4-(4-chlorobenzyloxy)-1-(2-ethylbutyl)benzene,
 3-chloro-4-(4-chlorobenzyloxy)-1-(1-methylbutoxy)benzene,
 1-sec-butoxy-3-chloro-4-(3,4-difluorobenzyloxy)benzene,
 1-sec-butoxy-3-chloro-4-[1-(4-chlorophenyl)ethoxy]benzene,
 1-sec-butoxy-3-chloro-4-(3-chlorobenzyloxy)benzene,
 3-chloro-1-(2-ethylbutyl)-4-(4-methylbenzyloxy)benzene, or
 3-chloro-1-isobutoxymethyl-4-(4-methylbenzyloxy)benzene.

6. A process for producing an aromatic compound of the formula:



wherein R¹ is a C₃-C₈ alkyl group, a C₃-C₈ alkoxy group, an alkoxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ alkenyl group, a C₃-C₈ alkenyloxy group, an alkenyloxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ haloalkyl group, a C₃-C₈ haloalkoxy group, a haloalkoxyalkyl group having 3 to 8 carbon atoms, a C₃-C₈ haloalkenyl group, a C₃-C₈ haloalkenyloxy group, a haloalkenyloxyalkyl group having 3 to 8 carbon atoms or a C₃-C₈ alkynyloxy group; R² is a halogen atom; R³ is, the same or different, a hydrogen atom, a halogen atom or a methyl group; R⁴ is a hydrogen atom or a methyl group; R⁵ is, the same or different, a hydrogen atom, a halogen atom, a C₁-C₄ alkyl group, a C₁-C₄ haloalkyl group, a C₁-C₄ alkoxy group, a C₁-C₄ haloalkoxy group, a C₁-C₄ alkylthio group, a C₁-C₄ haloalkylthio group, a 3,4-methylenedioxy group, a methoxymethyl group, a cyano group or a nitro group; m is an integer of 1 to 3; and n is an integer of 1 to 5, which comprises (a) reacting a phenol of the formula:



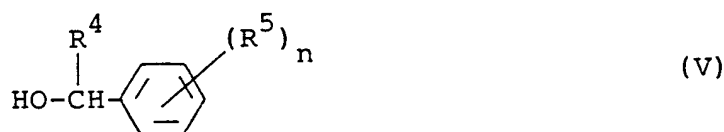
wherein M is an alkali metal atom or a hydrogen atom and R¹, R², R³ and m are each as defined above with a halide of the formula:



wherein A is a halogen atom and R^4 , R^5 and n are each as defined above, or (b) reacting a phenol compound of the formula:



wherein R^1 , R^2 , R^3 and m are each as defined above with an alcohol of the formula:



wherein R^4 , R^5 and n are each as defined above.

- 30
7. The process according to claim 6, wherein the reaction in the step (a) is carried out in an inert solvent in the presence of a base at a temperature of from about -20°C to the boiling point of the inert solvent.
 8. The process according to claim 6, wherein the reaction in the step (b) is carried out in an inert solvent in the presence of a dehydrating catalyst or agent at a temperature of from about -20 to 200°C or the boiling point of the inert solvent.
 9. A composition for controlling insect pests which comprises an effective amount of the aromatic compound according to any one of claims 1 to 5 and an inert carrier.
 - 40 10. A method for controlling insect pests which comprises applying an effective amount of the aromatic compound according to any one of claims 1 to 5 to the insect pests or the locus where the insect pests propagate.
 - 45 11. Use of the aromatic compound according to any one of claims 1 to 5 as an agent for controlling insect pests.
- 50
- 55